

Azure and the Internet of Things

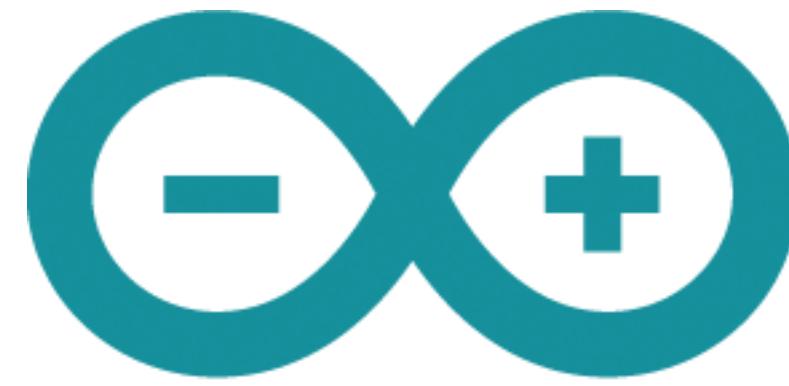
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Xamarin MVP, Microsoft MVP, Xamarin Insider



- The **Internet of things** (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.

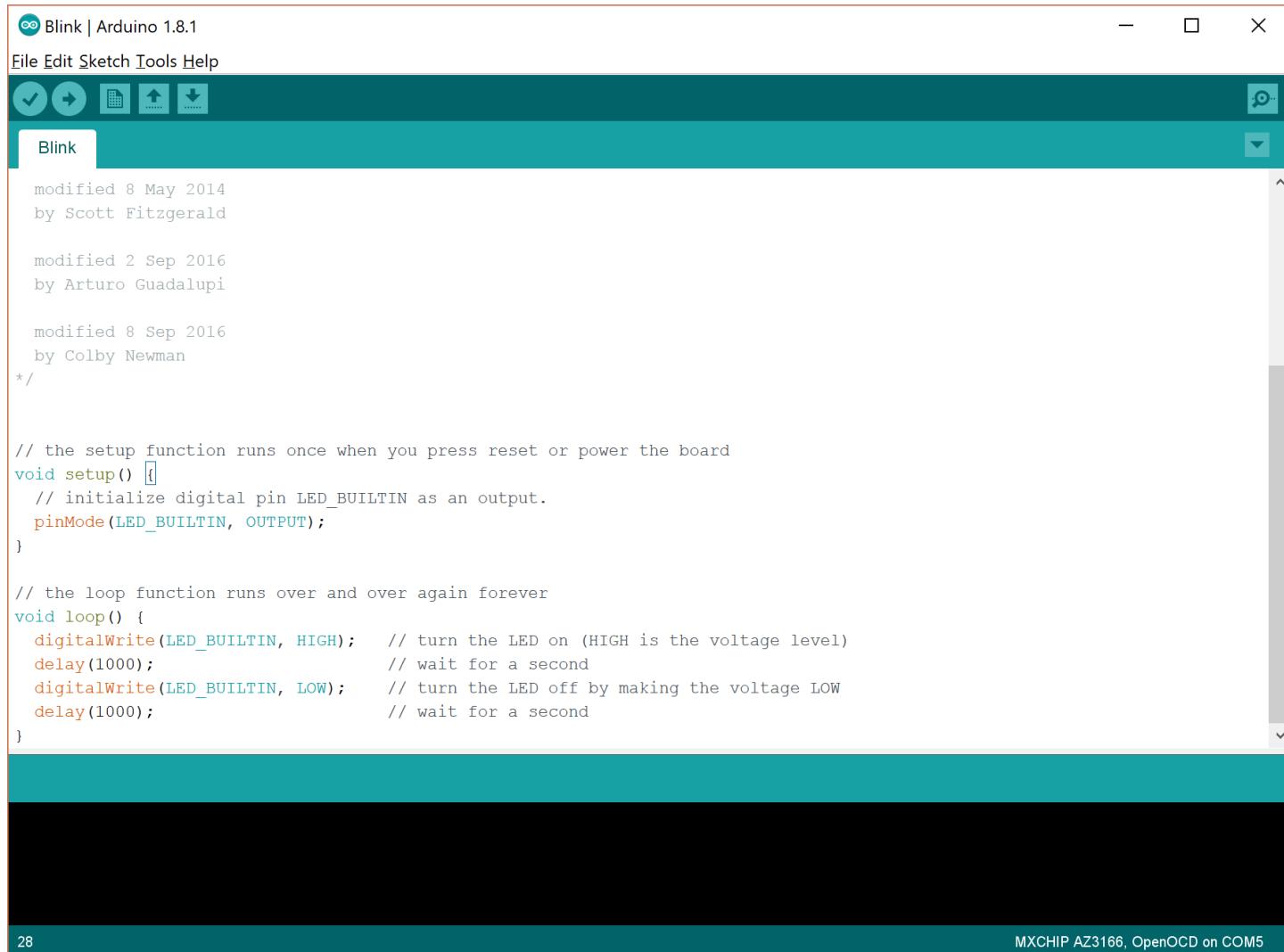
What is this talk about?

- Not an electronics tutorial
 - <http://www.instructables.com/id/Basic-Electronics/>
- Overview of some devices and see what you can do with them
- Connect devices to Azure
- Wide not deep
- Hopefully inspire you to build stuff! ☺



ARDUINO





The screenshot shows the Arduino IDE interface with the title bar "Blink | Arduino 1.8.1". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for save, undo, redo, upload, and download. The main window displays the "Blink" sketch. The code is as follows:

```
modified 8 May 2014
by Scott Fitzgerald

modified 2 Sep 2016
by Arturo Guadalupi

modified 8 Sep 2016
by Colby Newman
 */

// the setup function runs once when you press reset or power the board
void setup() {
    // initialize digital pin LED_BUILTIN as an output.
    pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
    digitalWrite(LED_BUILTIN, HIGH);      // turn the LED on (HIGH is the voltage level)
    delay(1000);                         // wait for a second
    digitalWrite(LED_BUILTIN, LOW);        // turn the LED off by making the voltage LOW
    delay(1000);                         // wait for a second
}
```

The status bar at the bottom left shows the page number "28" and at the bottom right shows the connection information "MXCHIP AZ3166, OpenOCD on COM5".

<https://www.arduino.cc/>

netduino

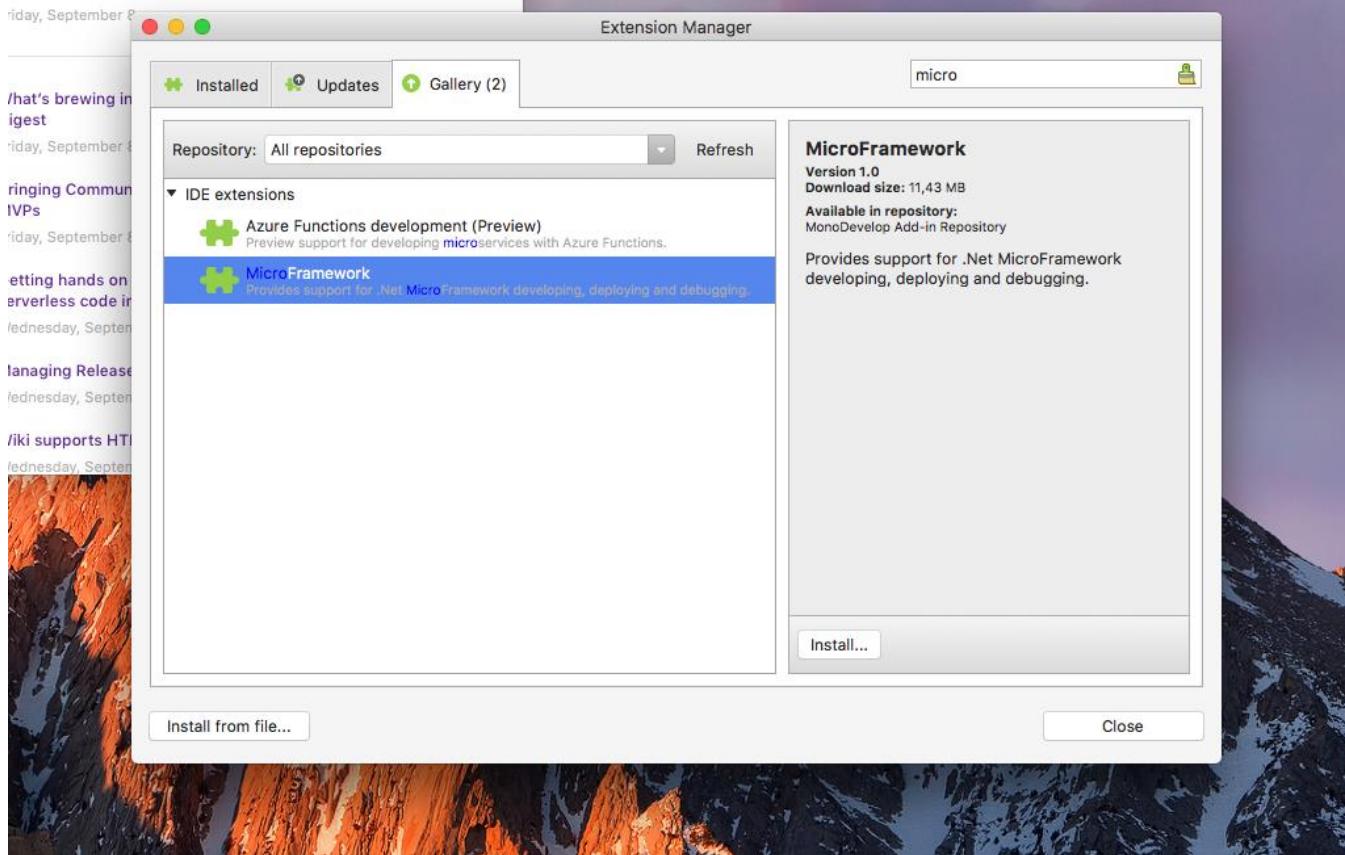
Netduino

- Open Source Hardware
- .NET Micro Framework
- C#
- Visual Studio 2015 (2017 extension in progress)
Visual Studio for the Mac
- <http://developer.wildernesslabs.co>

Extension

General availability of App Service on Linux and Web .app for Containers

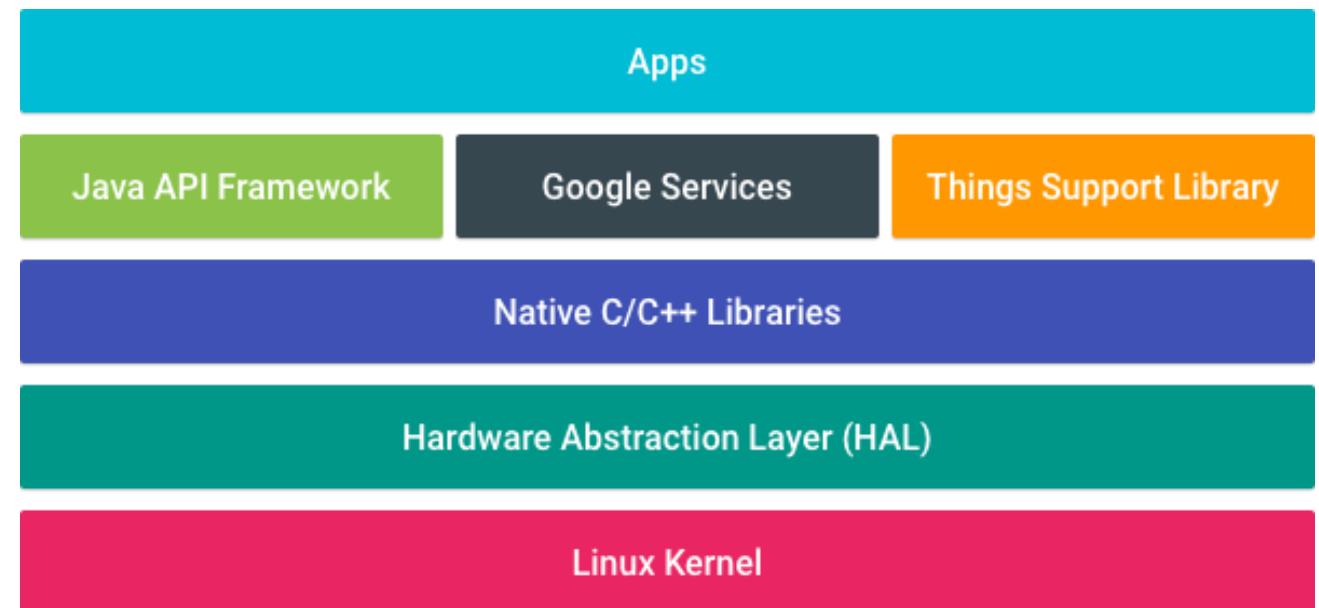
Applications are changing the pace of business today – from delivering amazing customer experiences, to transforming internal operations. To keep pace, developers need solutions that help them quickly build, deploy and scale applications without having to maintain the underlying web servers or operating systems. Azure App Service delivers this experience and currently hosts more than...



android
things

Android Things

Android Things makes developing connected embedded devices easy by providing the same Android development tools, Android framework, and Google APIs



Now in Preview 0.51

Things Support Library

Peripheral I/O API

The Peripheral I/O APIs let your apps communicate with sensors and actuators using industry standard protocols and interfaces. The following interfaces are supported: GPIO, PWM, I2C, SPI, UART.

User Driver API (GPS, HID, Sensors, Audio)

User drivers extend existing Android framework services and allow apps to inject hardware events into the framework that other apps can access using the standard Android APIs.

Behavioral Changes

- **Core application packages**
- Android Things doesn't include the standard suite of system apps and content providers. Avoid using common intents as well as the following content provider APIs in your apps: CalendarContract, ContactsContract, DocumentsContract, DownloadManager, MediaStore, Settings, Telephony, UserDictionary, VoicemailContract
- **Displays are optional**
- **Google Play Services partially available**
- **Home activity support**
- Android Things expects one application to expose a "home activity" in its manifest as the main entry point for the system to automatically launch on boot.

Development Boards

Intel® Edison



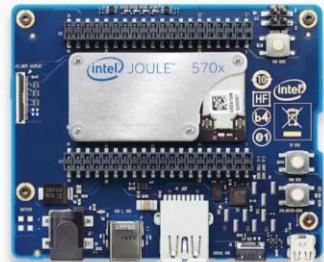
NXP Pico i.MX6UL



Raspberry Pi 3



Intel® Joule™ 570x



NXP Argon i.MX6UL



Getting Started

Download:

<https://developer.android.com/things/preview/download.html>

SD Card Reader

8 Gig SD Card

Ethernet Cable (or for headless USB TTL Cable)

HDMI Cable for display

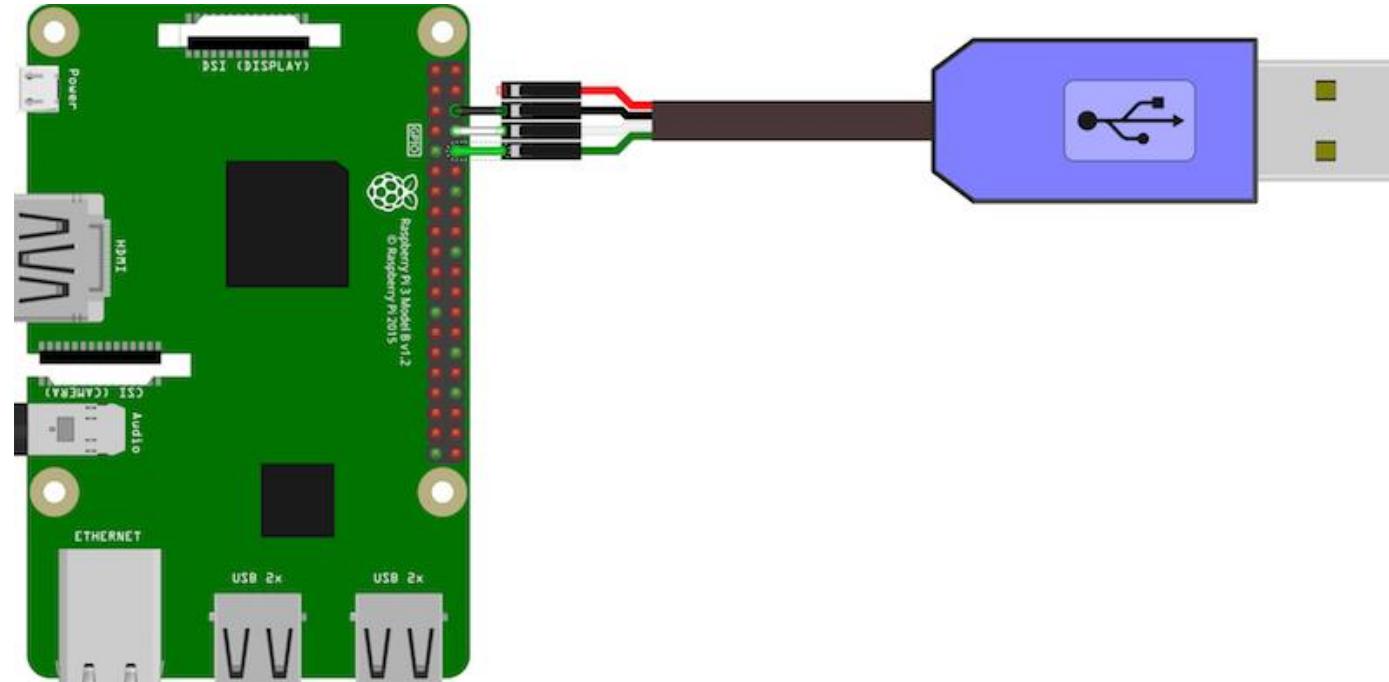
Android Studio or Xamarin.Android (Stable)

Getting Started - Wifi

Adb shell

```
am startservice \
-n com.google.wifisetup/.WifiSetupService \
-a WifiSetupService.Connect \
-e ssid <Network_SSID> \
-e passphrase <Network_Passcode>
```

Getting Started – Wifi (Raspberry Pi)



fritzing

<http://www.putty.org/>

Getting Started



<https://shop.pimoroni.com/products/rainbow-hat-for-android-things>

Google Contrib Drivers

Things Support Library

Sparkfun ADC Block for Intel Edison - adcv2x

Apa102 RGB LED strip

Bmx280 temperature and pressure sensor

Push button over GPIO

Cap12xx capacitive touch buttons

GPS

Ht16k33 7-digit alphanumeric segment

Mma7660fc accelerometer sensor

PWM speaker/buzzer

Metadriver for the Rainbow HAT

Metadriver for the Sense HAT

Ssd1306 OLED display

Tm1637 4-digit numeric segment display

<https://github.com/apead/Xamarin-AndroidThings-Contrib>

<https://github.com/androidthings/contrib-drivers>

Demo

- Android Things Azure IoT Hubs Demo
- Azure IoT Hubs
- Android Things on Raspberry Pi 3

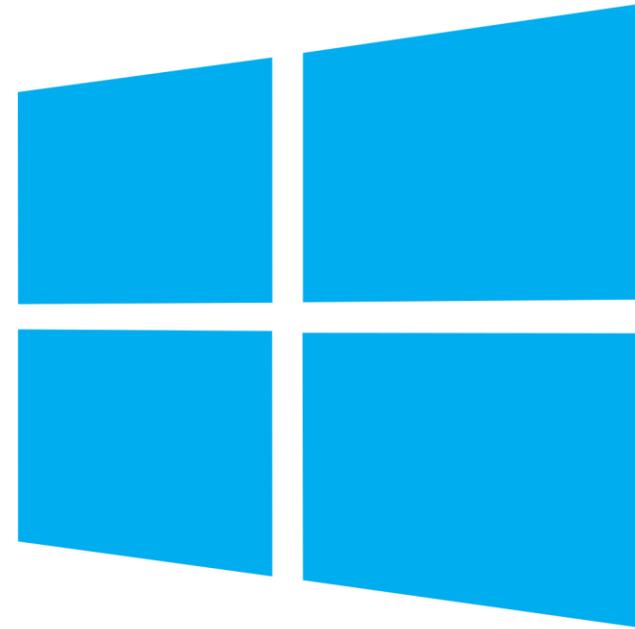
Xamarin Nuget

Android Things Support Library

<https://www.nuget.org/packages/Xamarin.Android.Things/0.4.1-devpreview>

Google Contrib Drivers

<https://www.nuget.org/packages/Xamarin.AndroidThings.Contrib.RainbowHat/0.42.0-beta>



Windows 10 IoT

One Windows Platform



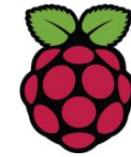
Windows 10 IoT Core

- C#
- XAML
- UWP
- Azure IoT Device Management
- Cortana support out the box
- Remote Display

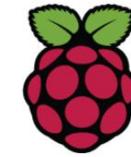
Development Boards



Raspberry Pi 2
Starter Pack



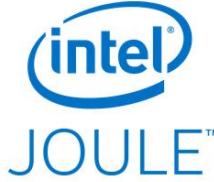
Raspberry Pi 2



Raspberry Pi 3



Dragonboard
410c



Intel Joule

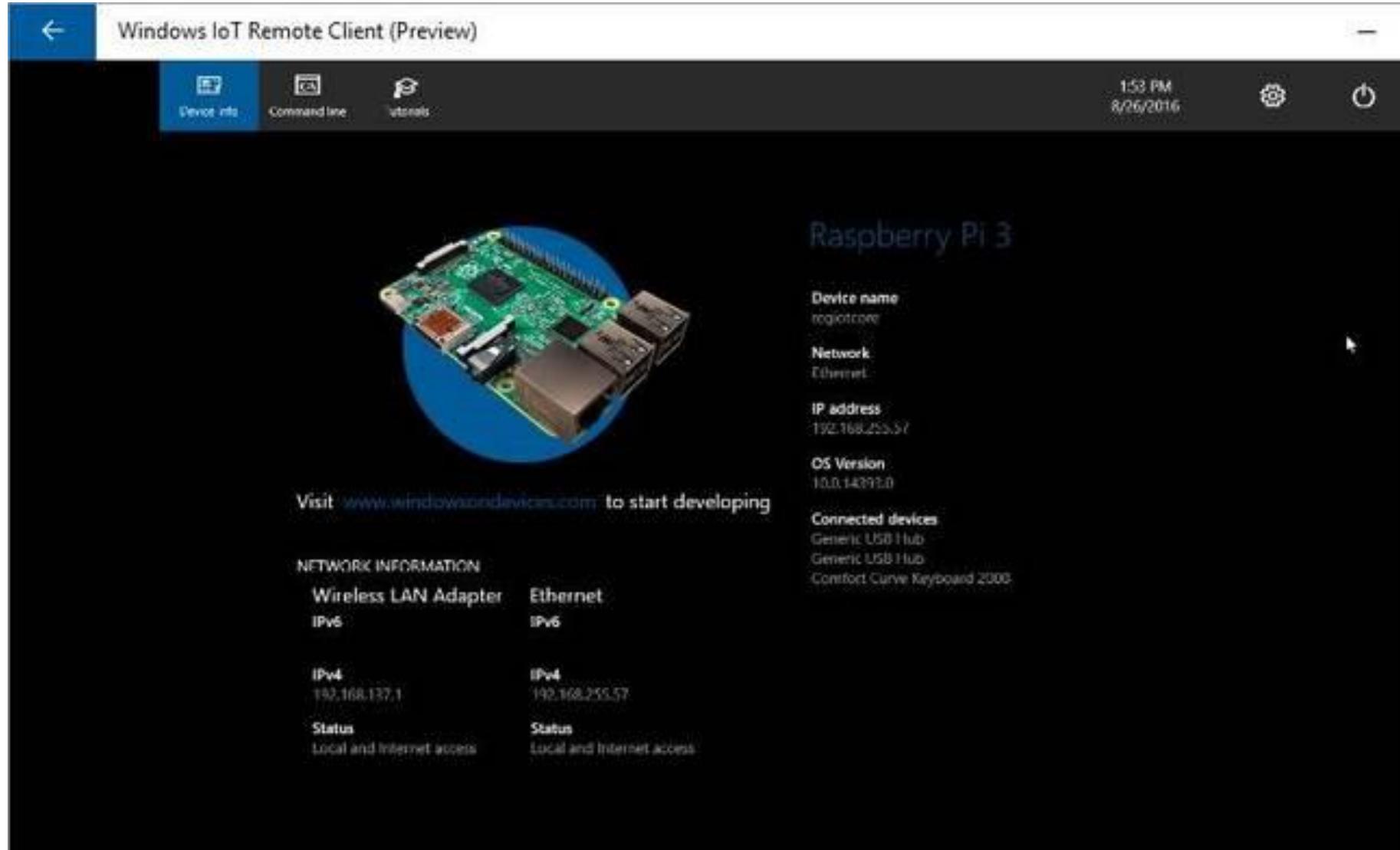


Minnowboard
Max



Intel Compute
Stick

Remote Client





IOT

Xamarin IoT

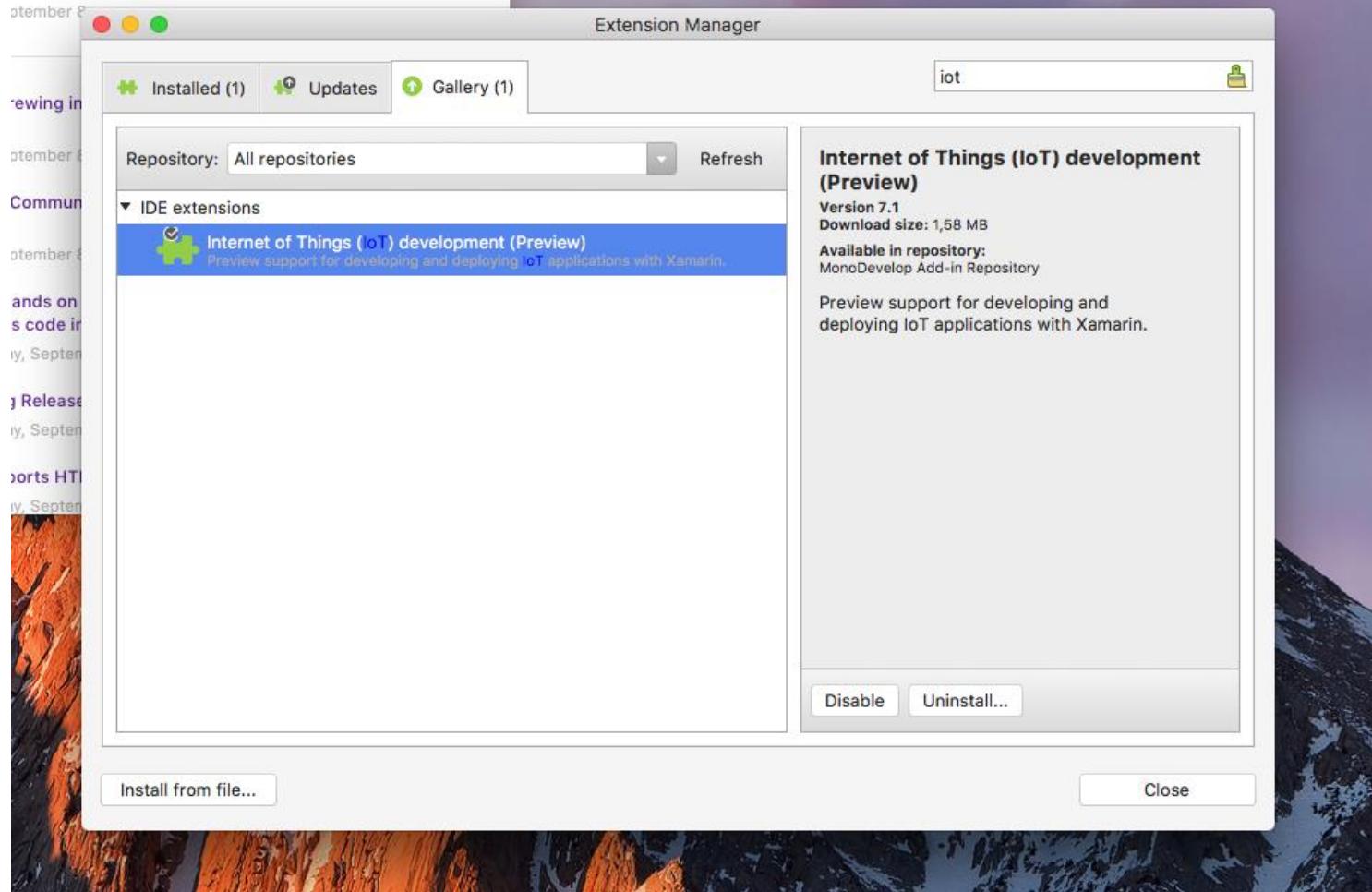
- IoT for all things Linux
- Support for devices, not supported by Android Things and Windows 10 IoT
- Cross Platform components
- Visual Studio 2017 Preview or Visual Studio for Mac

Getting Started

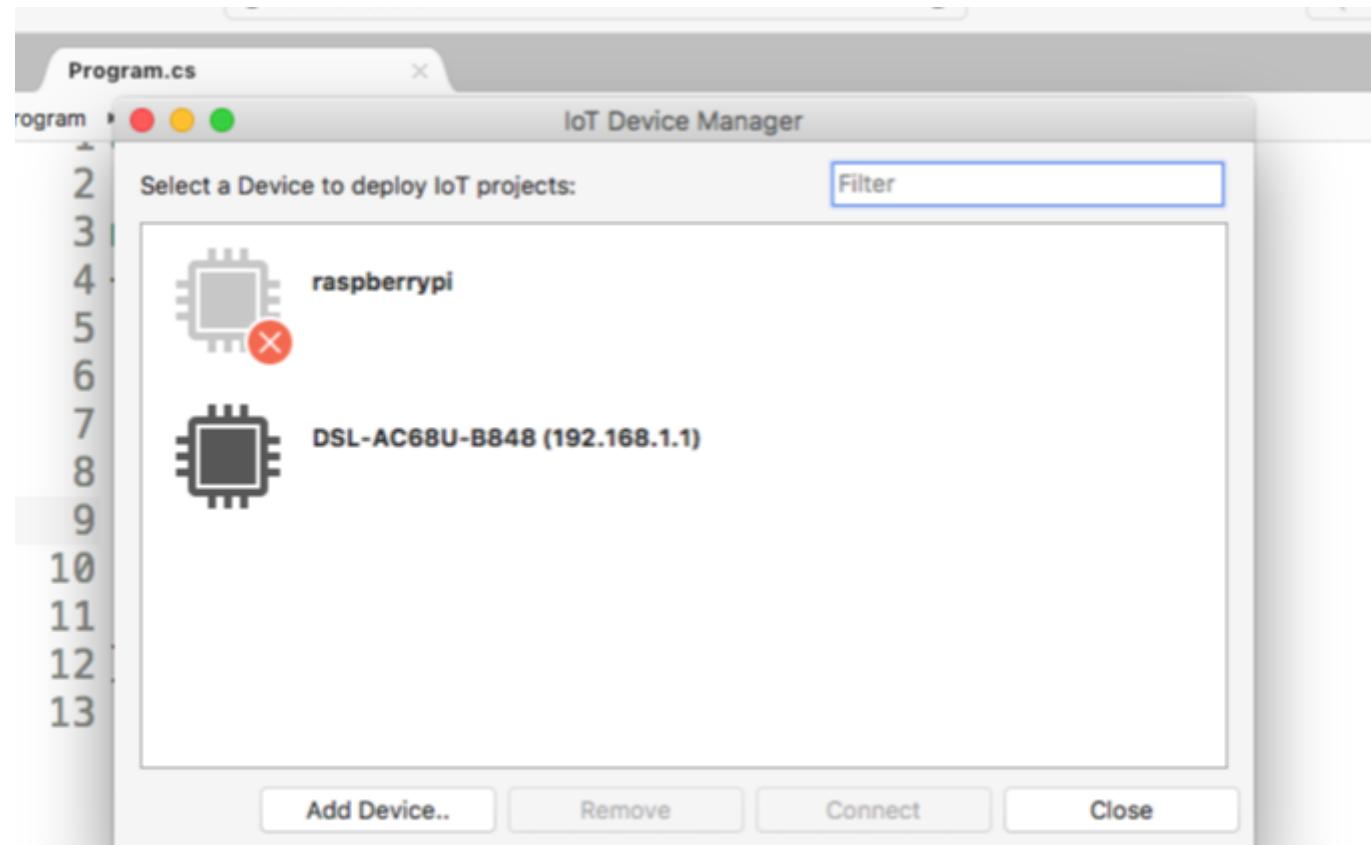
- A device with a Linux Distribution
- SSH Enabled
- Visual Studio 15.4 Preview with Xamarin Out of Band Updater or Visual Studio for the Mac Alpha

Extension

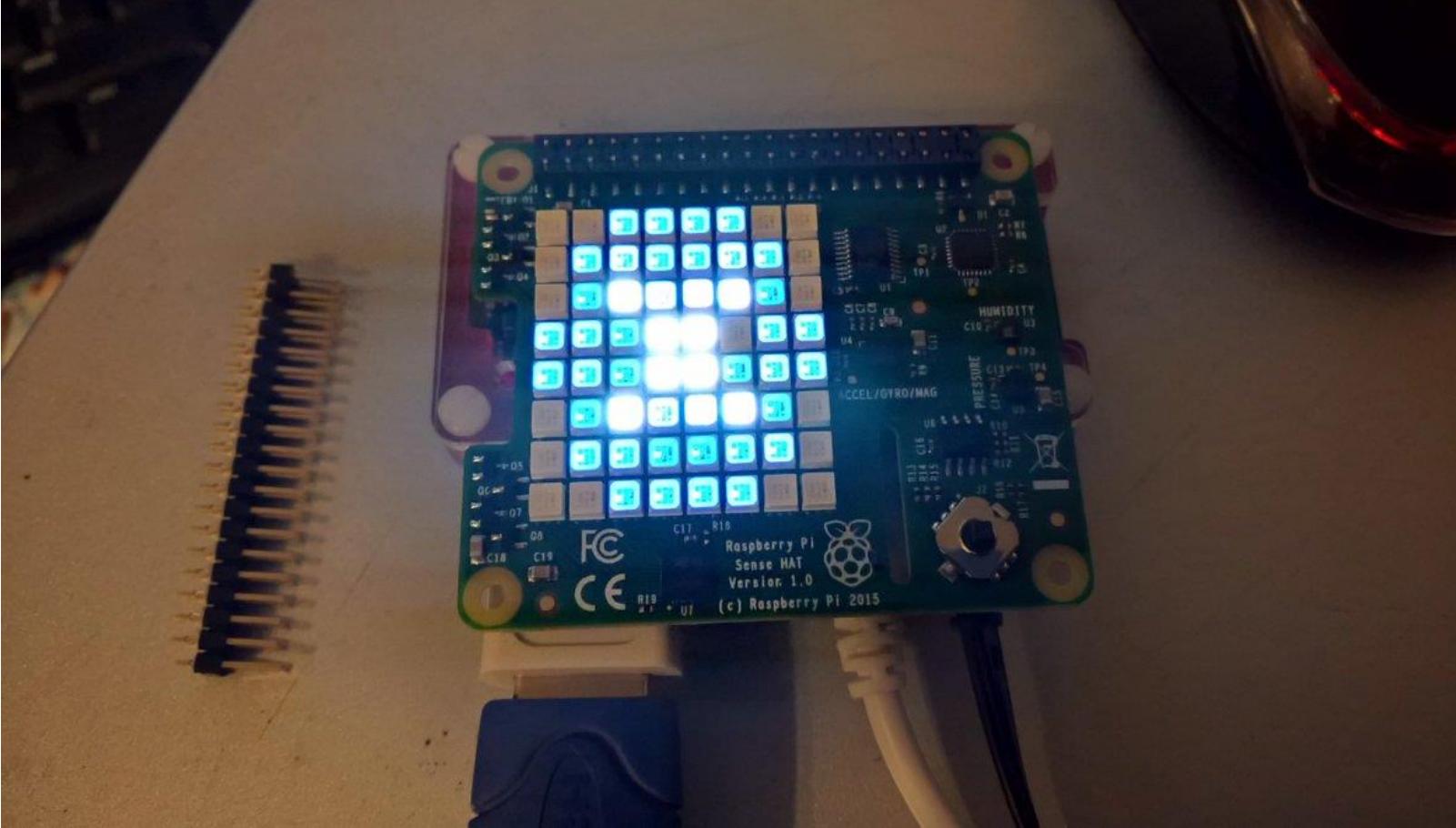
1 quickly build, deploy and scale applications without
maintain the underlying web servers or operating
Azure App Service delivers this experience and
hosts more than...



Remote Device



Iot Components



Iot Components

IOT Sharp

<https://github.com/xamarin/xamarin-iot-samples/tree/master/IoTSharp.Components>

Raspberry Sharp

<https://github.com/raspberry-sharp>

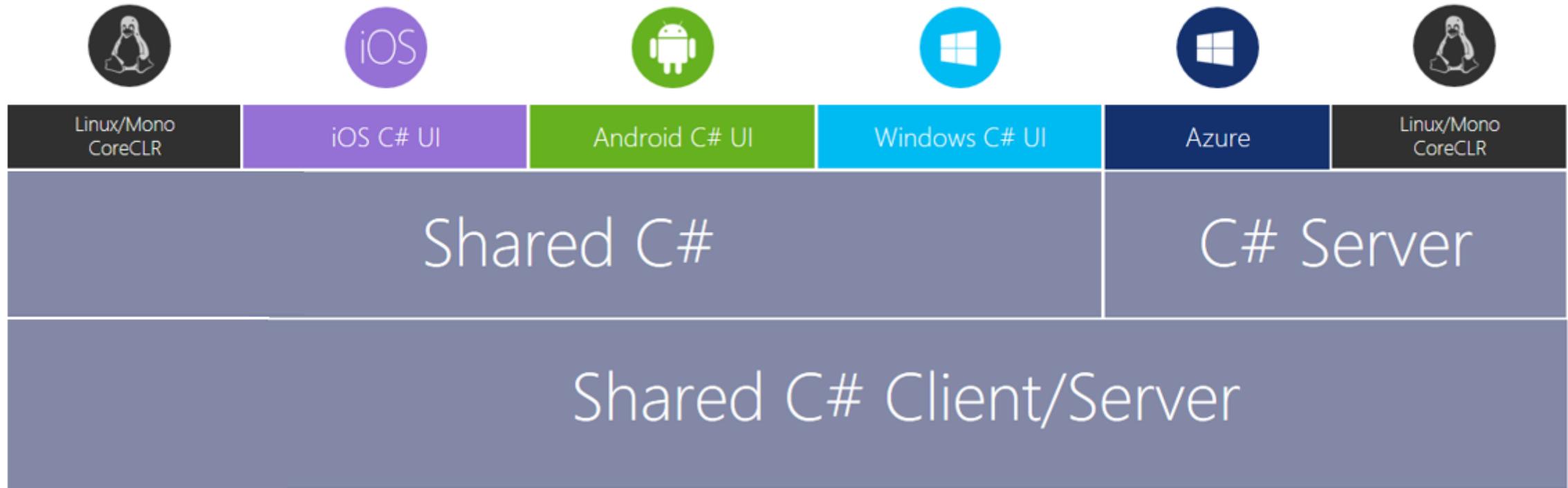
What can I do in Visual Studio?

- .NET MF (Micro Framework) (eg. Netduino)
- Arduino
 - Visual Micro
 - Visual Studio Code (Arduino extension is now Open Source)
- Windows 10 IoT Core
- Android Things
- Xamarin IoT

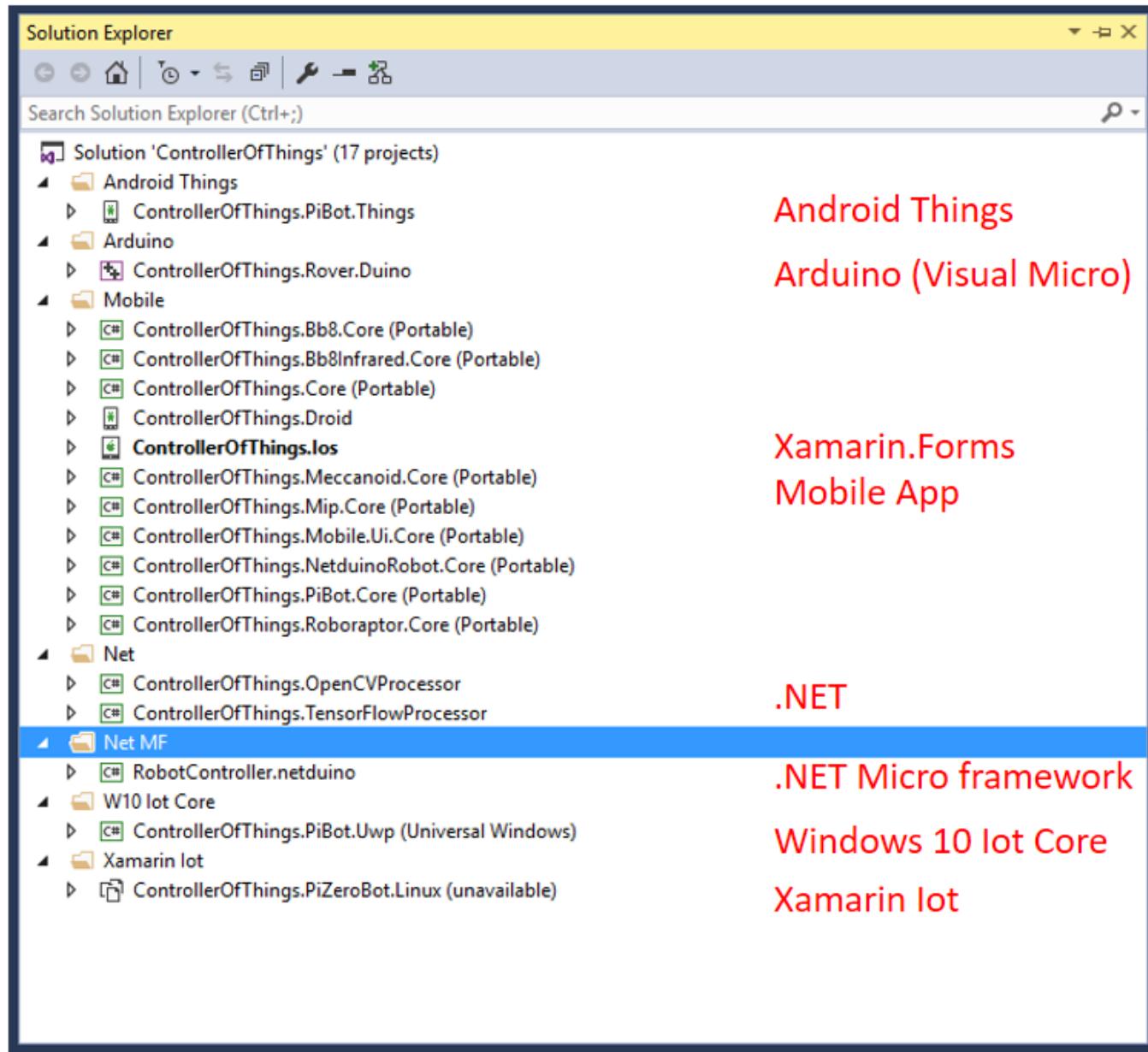
Arduino

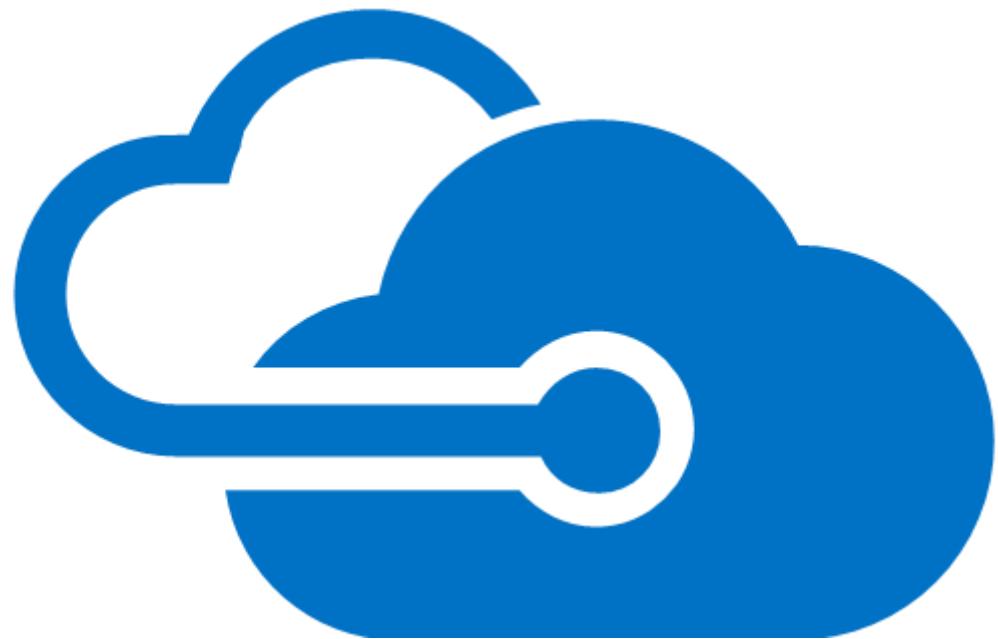
- Visual Micro: <http://www.visualmicro.com/>
- Visual Studio Code Extension:
<https://blogs.msdn.microsoft.com/iotdev/2017/07/06/visual-studio-code-extension-for-arduino-is-now-open-sourced/>

Mobile - IoT - Server



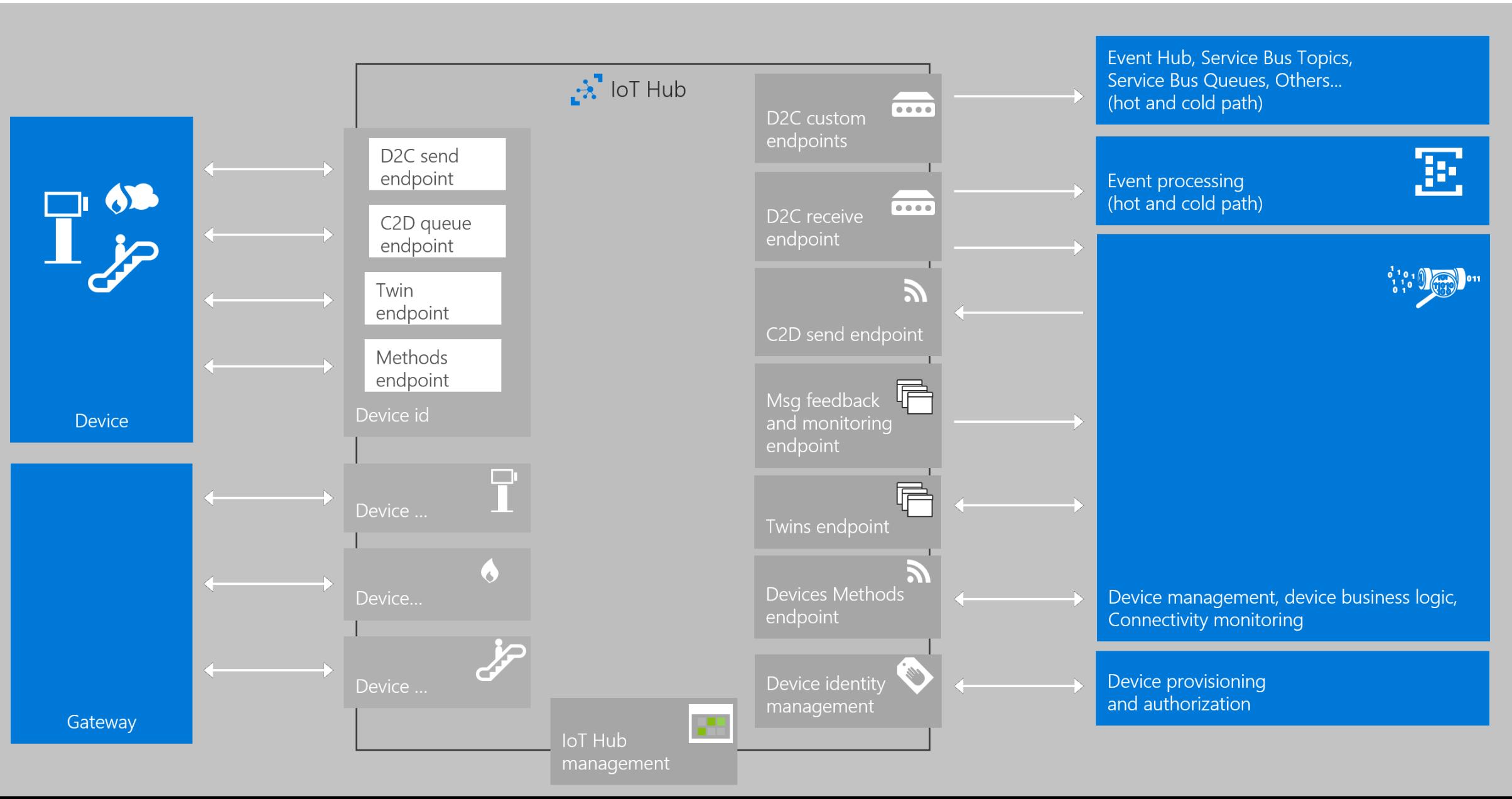
Shared C# codebase • 100% native API access • High performance





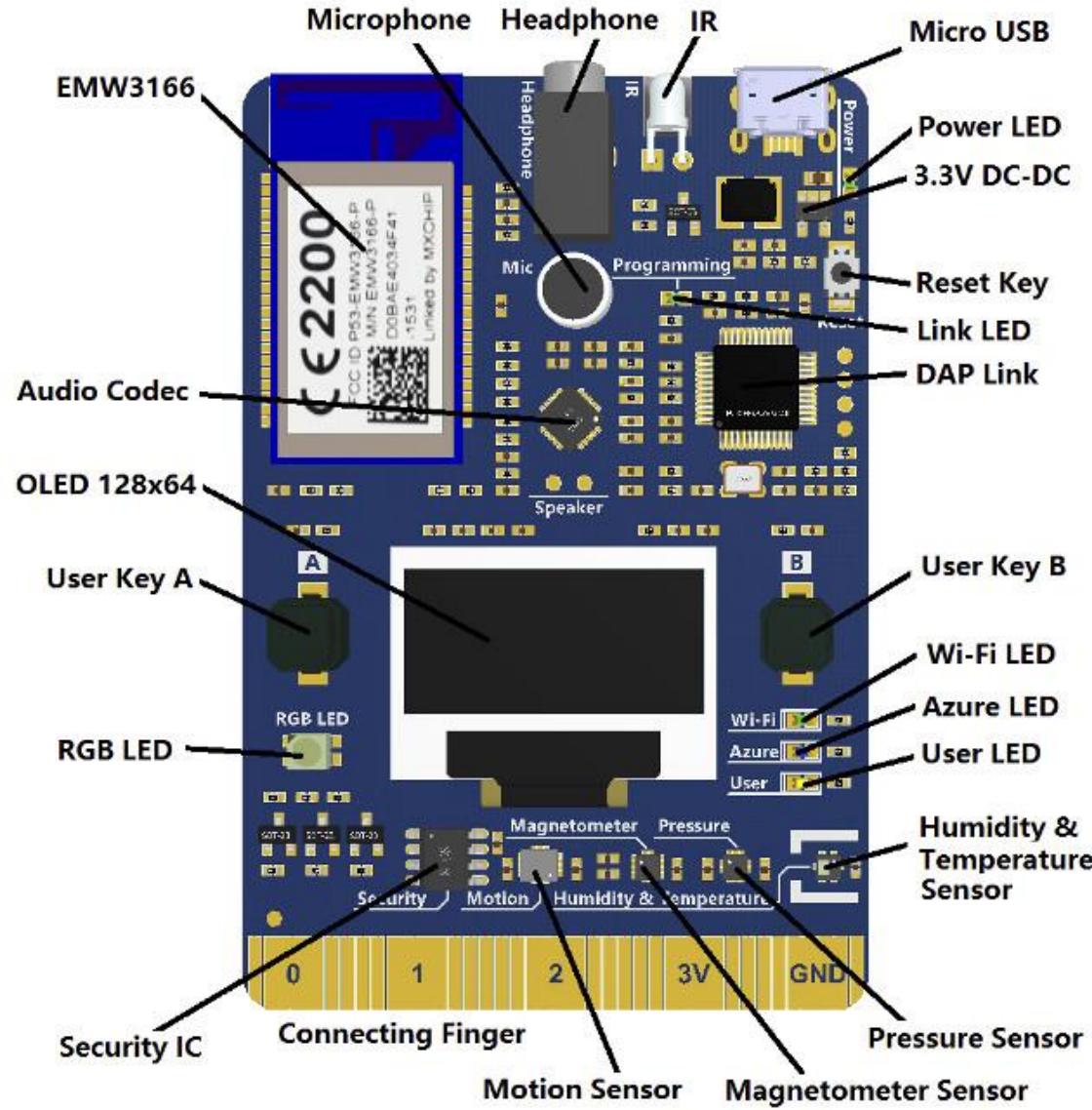
Azure IoT Hubs

- Establish bi-directional communication with billions of IoT devices
- Work with familiar platforms and protocols (standard and custom protocols, including HTTP, Advanced Message Queuing Protocol (AMQP), and MQ Telemetry Transport (MQTT))
- Authenticate per device for security-enhanced IoT solutions



Getting Started with Azure IoT Hub

- Create an Azure IoT Hub
- Create Device Identities
- Use the client SDKs (service and device)
- Use the dev tools to debug/monitor
- Play with the Azure IoT Starter Kits



MXChip Kit: <https://microsoft.github.io/azure-iot-developer-kit/>

Creating an Azure IoT Hub

- Azure Portal
 - <https://portal.azure.com>
- ARM template
 - <https://azure.microsoft.com/en-us/resources/templates/>
- Azure CLI
 - <https://github.com/Azure/azure-cli> (v2.0 Python)
 - <https://github.com/Azure/azure-xplat-cli> (v1.0 Node.js)
- Powershell
 - <https://docs.microsoft.com/en-us/powershell/azureps-cmdlets-docs/>

Azure Internet of Things

New X

Search the marketplace

MARKETPLACE See all

- Compute >
- Networking >
- Storage >
- Web + Mobile >
- Databases >
- Data + Analytics >
- AI + Cognitive Services >
- Internet of Things >**
- Enterprise Integration >
- Security + Identity >
- Developer tools >
- Monitoring + Management >
- Add-ons >
- Containers >
- Blockchain >

RECENT

-  **Notification Hub**
Microsoft
-  **IoT Hub**
Microsoft

Internet of Things X

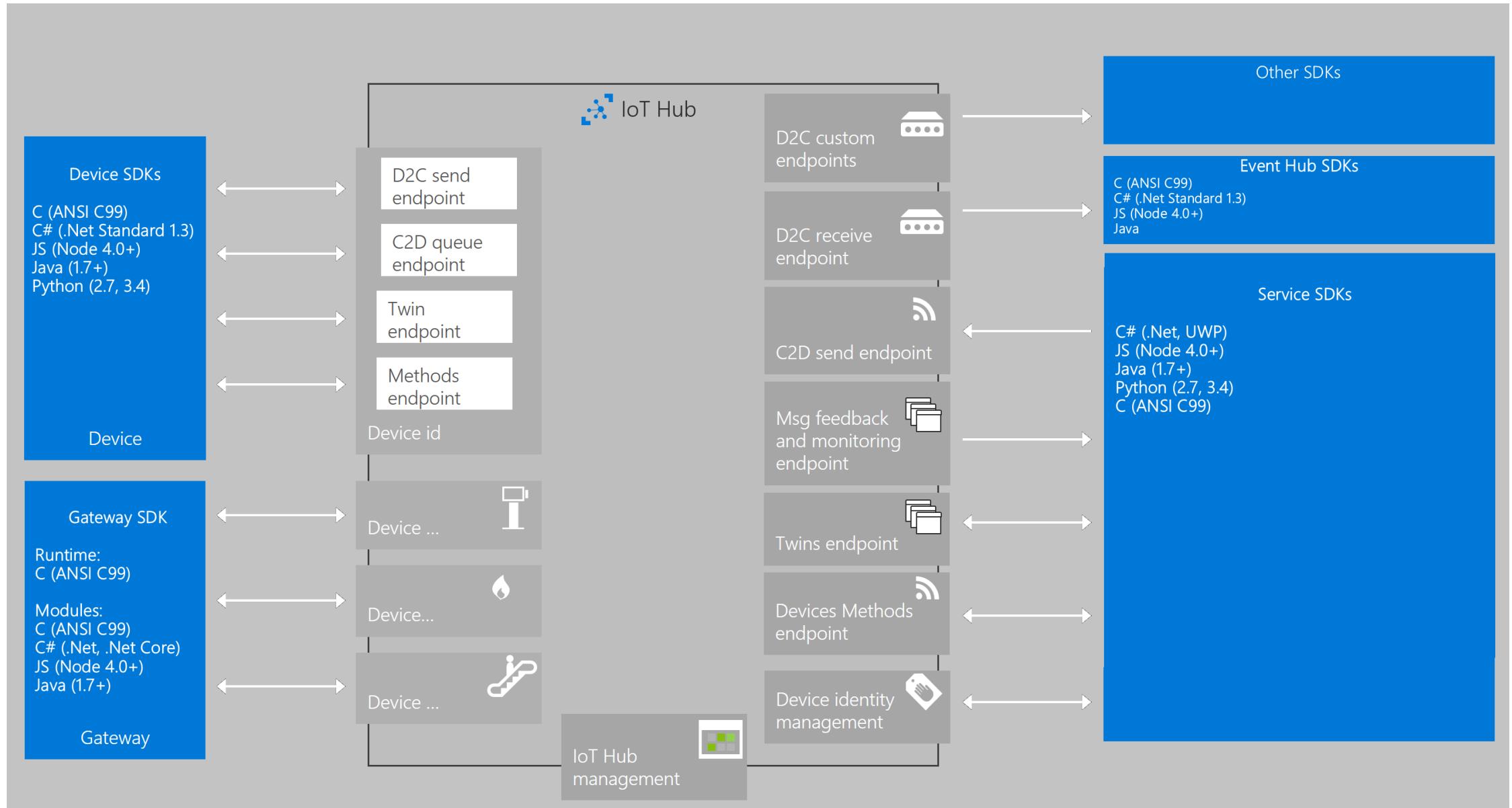
FEATURED APPS See all

-  **IoT Hub**
Connect, monitor and manage IoT devices
-  **Event Hubs**
Cloud-scale telemetry ingestion from websites, apps, and devices.
-  **Time Series Insights (preview)**
Azure Time Series Insights is a fully managed analytics, storage, and visualization service that makes it
-  **Stream Analytics job**
Unlock real-time insights from streaming data
-  **Machine Learning Workspace**
A workspace contains your Machine Learning experiments and predictive web services.
-  **Machine Learning Web Service**
Web Service for your machine learning model
-  **Notification Hub**
Broadcast push notifications to millions of users or tailor notifications to individual users.
-  **HDInsight**
Cloud-based Big Data service. Hadoop and other popular big data solutions.
-  **DataStax Enterprise**

Azure IoT Hub Developers tools

- IoTHub-explorer : node based CLI
 - npm install -g iothub-explorer
- Device Explorer: Windows app
 - Installer in releases of github.com/azure/azure-iot-sdk-csharp
- Device discovery CLI
 - npm install -g device-discovery-cli
- IoTHub Diagnostics tool
 - npm install -g iothub-diagnostics
- Azure IoT Toolkit Extension for Visual Studio Code
 - Look for « Azure IoT Toolkit » in the VS Code extensions library
- Arduino Extension for Visual Studio Code
 - Look for « Arduino » in the VS Code extensions library

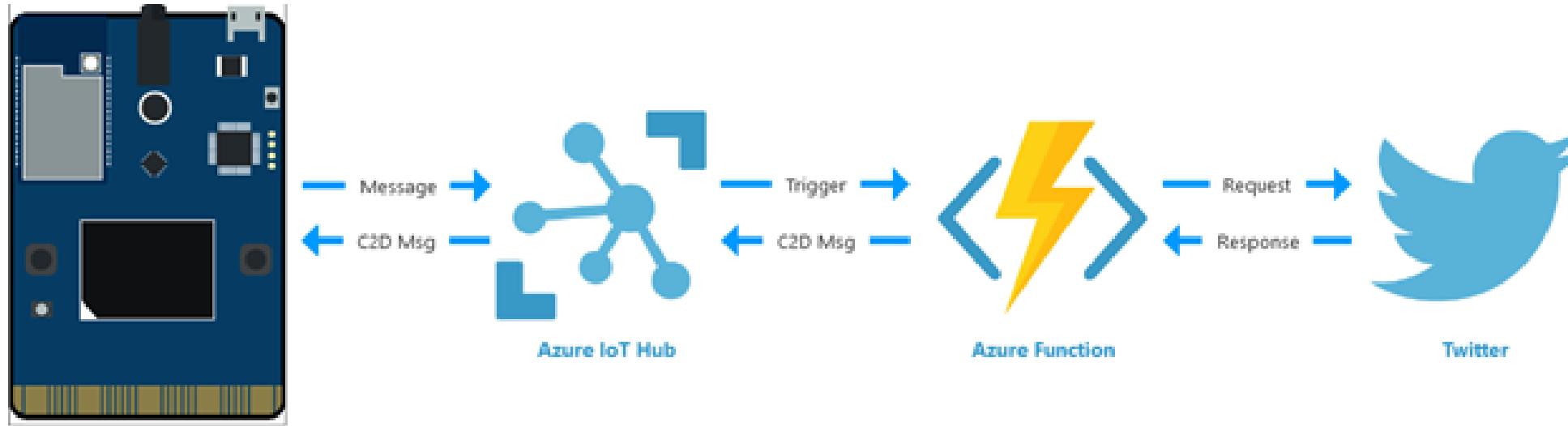
SDKs



Device SDKs platform/OS support

- Android (Java or Xamarin)
- Arduino
- Debian Linux (v 7.5)
- ESP8266
- Fedora Linux (v 20)
- FreeRTOS
- iOS (Xamarin)
- mbed OS (v 2.0)
- OpenWRT
- Raspbian Linux (v 3.18)
- STM32
- TI RTOS
- Ubilinux (v3.0)
- Ubuntu Linux (v 14.04)
- Windows Desktop (7, 8, 10)
- Windows IoT Core (v 10)
- Windows Server (v 2012 R2)
- Yocto Linux (v 2.1)
- ... and more

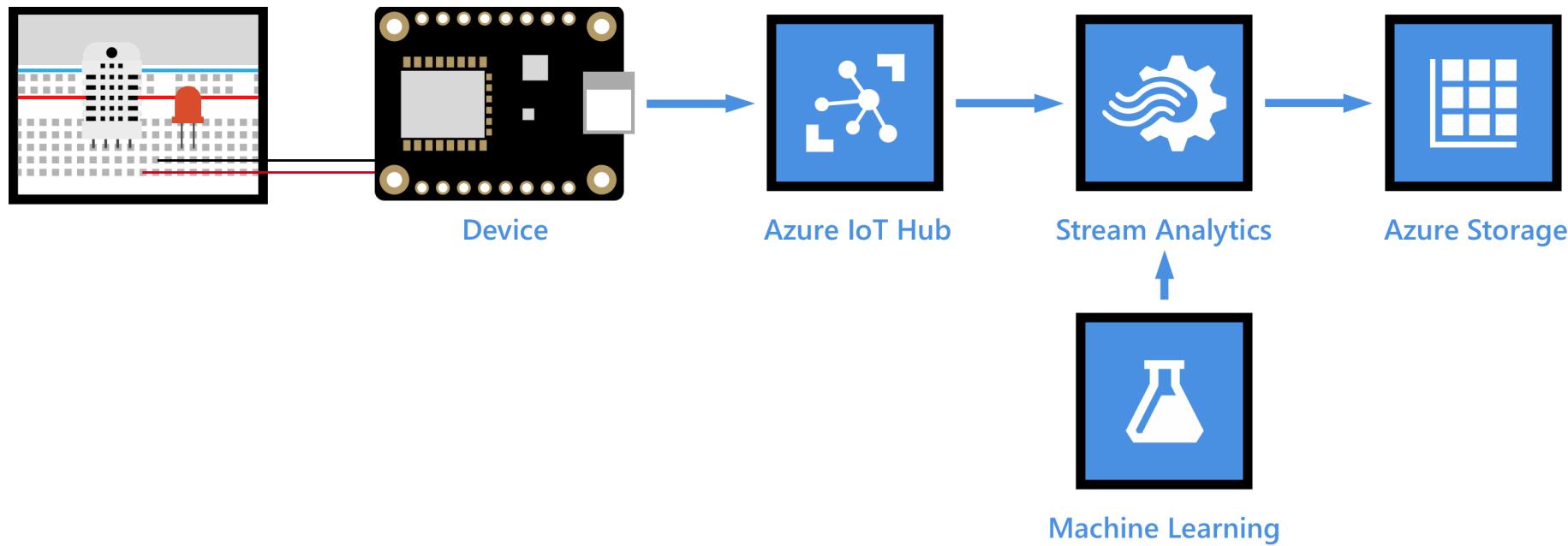
Azure Hubs



Demo

- MX Chip Azure IoT Kit Twitter Demo
- Azure Functions
- Visual Studio Code

Azure Hubs



Demo

- MX Chip Azure IoT Kit Weather Prediction Demo
- Azure Stream Analytics
- Azure IoT Hubs
- Azure Machine Learning

Machine Learning

Experiments - Microsoft / Allan

Secure | https://studio.azureml.net/Home/ViewWorkspaceCached/ecab5e5bcbff4437adb3d79c49902c2a?#Workspaces/Experiments/Experiment/ecab5e5bcbff4437...

Microsoft Azure Machine Learning Studio

Allan Pead-Free-Workspace

Weather prediction model

Finished running ✓

Properties Project

Experiment Properties

- START TIME 9/12/20...
- END TIME 9/12/20...
- STATUS CODE Finished
- STATUS DETAILS None

Go to web service

Summary

Enter a few sentences describing your experiment (up to 140 characters).

Description

Enter the detailed description for your experiment.

Quick Help

Search experiment items

Saved Datasets

Data Format Conversions

Data Input and Output

Data Transformation

Feature Selection

Machine Learning

OpenCV Library Modules

Python Language Modules

R Language Modules

Statistical Functions

Text Analytics

Time Series

Web Service

Deprecated

Two-Class Logistic Regression ✓

Select Columns in Dataset ✓

Edit Metadata ✓

Clean Missing Data ✓

Execute R Script ✓

Train Model ✓

Score Model ✓

Split Data ✓

Select Columns in Dataset ✓

Web service input

Web service output

Mini Map

NEW

RUN HISTORY

SAVE

SAVE AS

DISCARD CHANGES

RUN

SET UP WEB SERVICE

PUBLISH TO GALLERY

Learn More about IOT

Android Things

<https://developer.android.com/things/hardware/index.html>

Xamarin IOT

<https://developer.xamarin.com/guides/cross-platform/iot/>

Visual Studio Code Arduino Extension

<https://marketplace.visualstudio.com/items?itemName=vsciot-vscode.vscode-arduino>

Azure Iot Hubs

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

<https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-weather-forecast-machine-learning>

Learn Xamarin

Local Slack Community

[#xamarin](https://zatech.slack.com)

Xamarin Learning Resources

<https://developer.xamarin.com/guides/>

Xamarin University

<https://www.xamarin.com/university>

Learn and share with your local community

Xamarin User Groups

Cape Town (@CTXUG)

Johannesburg (@GXUGSA)

Durban (@DXUGSA)

Allan Pead

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Xamarin Insider



Email: adpead@gmail.com

Blog: <http://www.explorationspace.co.za>

Twitter: @adpead

Learn by Play!! Anything is Possible!



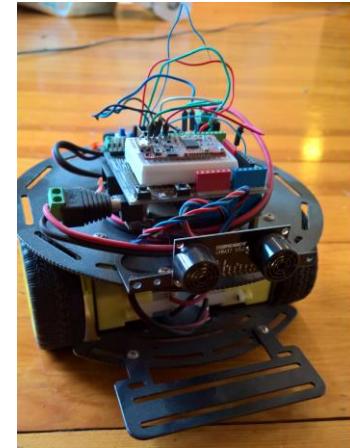
Meccadroid –
Xamarin.Android,
LattePanda,
OpenCV,
Cognitive
Services,
TensorFlow



MIP and Mipsaur.
Xamarin Forms,
Bluetooth,
Monkey Robotics,
MipSDK



Sphero – Xamarin
Forms, Bluetooth



.NET MF, Xamarin
Forms, Bluetooth,
Monkey Robotics



BB8, Xamarin
Forms,
Infrared

100% API Access

100% Native

Anything you can do in Java, Kotlin, Objective C, Swift you can do in C# and Xamarin