AGENDA

• Quick Recap on the Internet of Things (IoT)
• Quick Recap on Universal Windows Platform (UWP)
• Electronics Fundamentals for Software Engineers
• Live demos: Windows 10 IoT Core on Raspberry Pi
• Tons of resource links to get you started

• Questions
IOT MARKET RECAP

Why should you care about all of this?

IOT 2010
**IOT 2016**

Medication adherence  
Health monitoring  
Pet tracking  
Behavior modification  
Object tracking  
Child and elder monitoring  
Sports and fitness  
Smart lighting  
Indoor navigation  
Beacons and proximity  
Trip tracking and car health

**HOME**

Smart appliances  
Food and nutrition tracking  
Sleep tracking  
Home security  
Home automation  
Leak detection

**WORKPLACE**

Office equipment  
Smart vending machines  
Bike rides, safety, and protection

**IOT MARKET GROWTH**

Explosion in Devices and Data

**Worldwide Connected Devices**

- Smart TVs
- Wearables
- Connected Cars
- Internet of Things
- Phones
- Notes
- Music
- IoT

**Worldwide Data Created**

- 2005: 135EB
- 2019: 442ZB

1 Digital Universe Forecast. IDC, April 2014
**DISRUPTIVE FORCES**

Moore's Law

Metcalf's Law

Koomey's Law

And more importantly:

*What can you do by combining and analyzing signals from all of these IoT devices?*

**IOT IS THE NEXT REVOLUTION**

- Hardware is Cheap
- Connectivity is Pervasive
- Development is Easy
- New Innovative Scenarios
**MICROSOFT IOT**

Comprehensive solutions from device to cloud

IoT Editions Power a Broad Range of Devices
- 25 years of history in embedded devices
- One Windows platform for all devices
- Enterprise-ready, OEM-ready, Maker-friendly
- Designed for today's IoT environments
- Scalable solutions from free Windows IoT Core to Windows IoT Enterprise on PC-Like Devices

Cloud-Based IoT Services & Solutions
- Easy to provision, use and manage
- Pay as you go, scale as you need
- Global reach, hyper scale
- End-to-end security & privacy
- Windows, Mbed, Linux, iOS, Android, RTOS support

**AZURE IOT SUITE**

REMOTE MONITORING SERVICE ARCHITECTURE

Devices
- Azure IoT SDK (OSS)
- Linux, RTOS, mbed, Windows, Android, iOS

Web App
- Storage Blobs
- DocumentDB
- Stream Analytics
- Event Hub
- Web Jobs
- Logic Apps

IOT Hub
- Azure Active Directory

Business Process
- ERP/CRM
RASPBERRY PI

- Full single-board computer with SoC
  - Average cost: $30 to $45
  - Model A, A+, B, B+ and Raspberry Pi 2 & 3
- Runs Linux – flavor of Debian called Raspbian
  - http://www.raspbian.org
- Huge accessory selection
- Programmable
  - Python
  - C# (Mono), etc.
- 5+ million units sold in first 3 years of manufacture, technically the largest computer manufacturer in UK!

NEW WINDOWS, NEW DEVICES

- Windows 10 IoT Core on the Raspberry Pi 2 & 3 (and other devices)
- http://dev.windows.com/iot
THE JOURNEY TO ONE WINDOWS...

Windows Desktop
Windows Phone
Xbox

Windows 10
ONE CORE OS
ONE APP PLATFORM
ONE STORE

IoT
HoloLens
Surface Hub

ON A FULL RANGE OF DEVICES...

Phone
Phablet
Small Tablet
Large Tablet
2-in-1s
(ToString or Laptop)
Classic
Laptop
Desktops & All-in-Ones

Surface Hub
Xbox

Holographic
IoT
TUNED TO EACH FORM FACTOR...

Windows for PCs
- Familiar desktop shell
- Broad hardware ecosystem
- Windows desktop application compatibility

Windows for phones
- Familiar mobile shell
- Rich telephony
- Windows phone app compatibility

Windows on Xbox
- 10' shell experience
- Shared gaming experiences
- Xbox One game and app compatibility

Windows for ...
- Form factor-appropriate shell experience
- Device-specific scenario support

One Core OS
- Base OS
- App and Device platform
- Runtimes and frameworks

WITH A UNIVERSAL APP PLATFORM...

Windows Universal Platform
- Common & Consistent APIs

Languages
- C++ /CX
- C#, VB
- JS
- More

UI Frameworks
- HTML
- Xaml
- DirectX

APIs
- WinRT/UWP
- Win32
- .NET
- Wiring

Deployment and Execution
- APPX
- Xcopy
- App Isolation
**AND SOME PRETTY COOL DEVICES...**

![Image of devices](image)

**...AND OPTIONS TO GROW/EXPAND**

<table>
<thead>
<tr>
<th>Windows 10 IoT Core</th>
<th>Windows 10 IoT Core Pro</th>
<th>Windows 10 IoT Mobile</th>
<th>Windows 10 IoT Enterprise</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>UWP</td>
<td>Same as IoT Core</td>
<td>UWP</td>
<td>UWP</td>
<td>.Net Micro</td>
</tr>
<tr>
<td>Headed or Headless</td>
<td>For OEMs &amp; ODMs</td>
<td>Handheld</td>
<td>Win32</td>
<td>Framework</td>
</tr>
<tr>
<td>Single user</td>
<td>Defer updates</td>
<td>Roles and identities</td>
<td>Headed or Headless</td>
<td>Windows</td>
</tr>
<tr>
<td>Single app</td>
<td></td>
<td>Multiple apps</td>
<td>Roles and identities</td>
<td>Embedded</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Multiple Win32 and UWP</td>
<td>Compact</td>
</tr>
</tbody>
</table>
**Universal Windows Platform (UWP)**

- One Operating System
  - One Windows core for all devices
- One App Platform
  - Apps run across every family
- One Dev Center
  - Single submission flow and dashboard
  - [http://dev.windows.com](http://dev.windows.com)
- One Store
  - Global reach, local monetization
  - Consumers, Business & Education

**Windows Core**

- The refactored common core
  - One hardware platform
  - Universal hardware driver
  - Standard network and I/O
- 86% of all UWP APIs shared across all Windows 10 SKUs
**Universal Windows Platform**

- Win32
- .Net languages
- C++
- MFC
- XAML
- WinJS
- HTML
- WinJS
- C++ & CX
- .Net languages
- WinJS

**Bridging technologies**

- Web Hosted aka "Westminster"
- Win32 Desktop aka "Centennial"
- Obj.C iOS aka "Islandwood"

**Windows 10**

- Operating System / Kernel
- Windows 10 IOT Core

App owns the whole user interface. Optimized for embedded use.

Deployment and debugging in Visual Studio.

Development-time management through web site, PowerShell, SSH, and more.
INSTALLING WINDOWS 10 ON A RASPBERRY PI

• Watch Episode 5 of The Maker Show
• https://channel9.msdn.com/Shows/themakershow/5
• Full video walkthrough with Kenny Spade
ELECTRICAL ENGINEERING FOR SOFTWARE ENGINEERS

- SPI: Higher speed, fewer available
- I2C: Lower speed, more available
- GPIO: DIY communication

RASPBERRY PI 2 (& 3) PIN MAPPING
**DEMO**

Hello World – Maker Edition with Windows 10 IoT Core

**DEMO SETUP**

- Development PC
- Raspberry Pi 3 with FEZ HAT
- Direct wired Ethernet for Deploy/Debug
- WiFi for cloud connectivity to Azure (optional)
ABOUT THE FEZ HAT

- On-Board Analog Input and PWM chips
- Two DC Motor Drivers, suitable for building small robots
- Terminal Blocks for wiring in DC motors without the need for soldering
- Two Servo Motor Connections
- Single Red LED
- Two Multi Color LEDs, connected to PWM for thousands of colors
- Light Sensor
- Accelerometer
- Temperature Sensor
- Two user buttons
- Terminal block with 2x Analog, 2x Digital I/O, 2x PWM and power
- Female headers with SPI, I2C, 3x Analog, 3x PWM
- Dedicated power input for driving the servo motors and DC motors

https://www.ghielectronics.com/catalog/product/500

DEMO

Hacking UWP Apps with the Raspberry Pi and the FEZ HAT from GHI Electronics

https://www.ghielectronics.com/catalog/product/500
ARUINO AND WINDOWS 10

- Arduino and Windows 10 work together to help you make amazing projects
- Support for Arduino Uno and Mega, as well as the new Arduino 101

RESOURCES

How do I get started? What should I buy? Any good tutorials out there?
**BUILD IOT LAB MODULES**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Learn about Windows 10 IoT Core on the Raspberry Pi 3</td>
</tr>
<tr>
<td>2</td>
<td>Learn about Microsoft Azure IoT without using a device (concurrent with Module 3)</td>
</tr>
<tr>
<td>3</td>
<td>Learn how to connect Windows 10 IoT Core with Microsoft Azure (concurrent with Module 2)</td>
</tr>
<tr>
<td>?</td>
<td>Get full access to all BUILD 2016 Code Labs at <a href="http://aka.ms/codelabs">http://aka.ms/codelabs</a></td>
</tr>
</tbody>
</table>

**THE MAKER SHOW**

Weekly Channel 9 show makers, hackers, builders and disassemblers
Hands-on demos and know-how, by makers for makers
[http://themakershow.io](http://themakershow.io)
Follow @TheMakerShow

W03 - Windows for Makers: Raspberry Pi, Arduino & IoT - Nick Landry
WHERE TO BUY MAKER STUFF?

- Sparkfun ([www.sparkfun.com](http://www.sparkfun.com))
- Adafruit ([www.adafruit.com](http://www.adafruit.com))
- Maker Shed ([www.makershed.com](http://www.makershed.com))
- Mouser Electronics ([www.mouser.com](http://www.mouser.com))
- Netgate ([www.netgate.com](http://www.netgate.com))
- Amazon ([www.amazon.com](http://www.amazon.com))
- Radio Shack ([www.radioshack.com](http://www.radioshack.com))
  - The retail stores are perfect when you need parts urgently

AZURE IOT STARTER KITS
GET STARTED QUICKLY

- **Raspberry Pi 2 Kit**
  Windows 10 and Raspbian
  Samples in C and C#

- **Feather M0 Wi-Fi Kit**
  RTOS
  Samples in Arduino IDE and C

- **Feather Huzzah ESP8266 Kit**
  RTOS
  Samples in Arduino IDE and C

- **Intel Edison Kit**
  Linux Yocto
  Samples in JavaScript (Node.js)

- **ThingDev Kit**
  RTOS
  Samples in Arduino and C

Start today: [http://azure.com/iotstarterkits](http://azure.com/iotstarterkits)
MAKE MAGAZINE

• Makezine.com
• Print & Digital

250+ MAKER PROJECTS TO TRY OUT

www.windowsondevices.com
Projects powered by hackster.io
https://microsoft.hackster.io

Check out the MS IoT GitHub for more Windows IoT Core samples:
https://github.com/ms-iot/samples
MAKER RESOURCES

• MS IoT GitHub (https://github.com/ms-iot/samples)
• Hackster (https://microsoft.hackster.io)
• HackADay (www.hackaday.com)
• Instructables (www.instructables.com)
• CreativeApplications (www.creativeapplications.net)

• Watch Episode 0 of The Maker Show: “Meet Your Makers”
  • http://themakershow.io

MAKER COMMUNITIES

• Reddit
  • https://www.reddit.com/r/maker
  • https://www.reddit.com/r/DoItYourself
• Stack Exchange – Electronics
  • http://electronics.stackexchange.com
MAKER BOOKS?

Maker Media (O'Reilly)
http://shop.oreilly.com/category/publishers/make.do

Packt Publishing
https://www.packtpub.com/hardware-and-creative

ARDUINO PROJECT HANDBOOK

• https://arduinohandbook.wordpress.com
FRITZING: ELECTRONIC DIAGRAMMING

- [http://fritzing.org](http://fritzing.org)

- Open-source hardware initiative that makes electronics accessible as a creative material for anyone
  - Software tool
  - Community website
  - Services

- Foster a creative ecosystem
- Allow user to document their prototypes & share with others
- Teach electronics in classrooms
- Layout and manufacture professional PCBs

MICROSOFT VIRTUAL ACADEMY

- Getting Started with the Internet of Things (IoT)
  - With Pete Brown, Tony Goodhew, Mat Velleso – Microsoft

- Course Outline
  - 01 | Introduction to IoT
  - 02 | Windows 10 and Universal Windows Platform Apps
  - 03 | Introduction to Windows 10 IoT Core
  - 04 | Introduction to Azure Services for IoT
  - 05 | Azure IoT Hub and Device Communications
  - 06 | Running Arduino Wiring Code on Windows 10 IoT Core
  - 07 | Creating Node.js Apps for Windows 10 IoT Core
  - 08 | Windows Remote Arduino and Virtual Shields

**MICROSOFT VIRTUAL ACADEMY**

- Programming Robotic Systems with Visual Studio
  - With Chris Howd & Paul Pardi, Microsoft
- Course Outline
  - 01 | Embedded Systems, Robotics, and this MVA Training Series
  - 02 | Getting Started with Arduino
  - 03 | Creating Your First Arduino Robot
  - 04 | Controlling a Robotic Arm
  - 05 | Integrating Advanced Sensors and Shields
  - 06 | Mapping Areas and Detecting Objects
  - 07 | Integrating Wireless Control and Communication
  - 08 | Looking Ahead

**MICROSOFT DX IOT RESOURCE LINKS**

- Bret Stateham
  - [https://github.com/bretstateham/iot](https://github.com/bretstateham/iot)
- Jeremy Foster: Intel Edison
  - [http://codefoster.com/edison](http://codefoster.com/edison)
- Stacey Mulcahy
  - [http://thebitchwhocodes.com/blog](http://thebitchwhocodes.com/blog)
- Paul de Carlo
  - [http://pjdecarlo.com](http://pjdecarlo.com)
- Nick Landry
  - [http://AgeofMobility.com](http://AgeofMobility.com)
IOT PANEL AT THINGS EXPO 2014

- Microsoft, IBM, Kaazing, Xively/LogMeIn & Aria
- http://aka.ms/iotpanel2014

HAVE FUN!
Go build something...
PLEASE HACK SAFELY!

THANK YOU!

Slides are posted in the conference repository. Demos are on GitHub. Please fill out an evaluation. Your feedback is important and appreciated.

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Twitter: @ActiveNick
Email: nick.landry@microsoft.com
Mobile Apps: [www.bigbaldapps.com](http://www.bigbaldapps.com)
LinkedIn: [www.linkedin.com/in/activenick](http://www.linkedin.com/in/activenick)
GitHub: [github.com/ActiveNick](http://github.com/ActiveNick)
Slideshare: [www.slideshare.net/ActiveNick](http://www.slideshare.net/ActiveNick)