



IoT Wireless Product Development using ZentriOS SDK and IBM Bluemix

v1.0 – Oct 28, 2016

Accelerating Your Success™

Introductions – San Jose Workshop

- **CYPRESS**
 - Mike Fortner (+ local Bay Area Cypress team...)
- **ZENTRI**
 - Julie Mullins and Dan Riedler
- **IBM**
 - Forest Lin (IBM Watson IoT Ecosystem Solutions)
- **AVNET**
 - Peter Fenn (Avnet Global Solutions)
 - Bryan Chen
 - (+ the local **San Jose Avnet** team...)



BCM4343W
IoT Starter Kit



Workshop Goals

- Learn techniques to rapidly develop cloud-connected products using:
 - Avnet BCM4343W Wi-Fi & BLE combo module,
 - Zentri (SDK, OS and DMS) and IBM Watson IoT (Bluemix)
- Gain proficiency with leading SDK Dev Tool and Reference Designs
- Build secure, connected products while managing status, version, location & more
- Define IoT apps in minutes using Node-RED visual editing to connect the physical world via IBM Watson IoT to additional IBM Bluemix cloud services
- Exercise the FREE enablement hardware kit bundle that you received!
 - Avnet BCM4343W IoT Starter Kit
 - 8x8 LED matrix Display Pmod
 - NXP FRDM-STBC-AGM01 Sensor Shield
 - Cypress WICED Sense2 BLE Tag
- Learn & benefit from online IoT resource sites hosted by Avnet...
CloudConnectKits.org and ArtOfThePossibility.com resources



Workshop Enablement Bundle

What is in your workshop bundle?

- BCM4343W IoT Starter Kit
- NXP FRDM-STBC-AGM01 Sensor Shield
- 8x8 LED Matrix Display Pmod
- Cypress WICED Sense2 BLE Tag
- IBM Bluemix account credit
- USB thumb-drive with tools and docs

IBM Bluemix
Account Credit



8x8 LED Matrix
Display Pmod



Cypress WICED Sense2 BLE Tag

- BCM20737L BLE SoC
- L5M6D3 Gyro + Accelerometer
- LIS3MDLTR eCompass
- LPS25HBTR Pressure sensor
- HTS221 Humidity + Temp. sensor



Bluetooth[®] SMART



FRDM-STBC-AGM01
NXP Sensor Shield

- FXAS21002C Gyroscope
- FXOS8700CQ Accelerometer + Magnetometer



Avnet BCM4343W IoT Starter Kit

- BCM4343W SoC Combo Module
- Ambient Light Sensor
- Arduino™ expansion connector
- Pmod™ expansion connector



Workshop Agenda - MORNING

Time	Who / What	Description	Duration
08:30	Avnet	Intro to BCM4343W SoC Module and IoT Starter Kit	20 min
09:00	Zentri	Zentri OS and SDK: How to build connected products	30 min
09:30	Hands-On: Lab1	Wi-Fi Scanner plus webpage controlled scrolling LED matrix display	45 min
10:15	Avnet / IBM	Connecting to IBM Watson IoT QuickStart	20 min
10:45	Hands-On: Lab2	IBM Watson IoT Quickstart Charting of Light levels, RSSI and NXP motion sensors	60 min
11:45	Hands-On: Demo1	Cypress SENSE2 BLE tag sensor system connected to IBM Watson IoT Platform	15 min
12:00	- Lunch! -		30 min

Workshop Agenda - AFTERNOON

Time	Who / What	Description	Duration
12:15	Hands-On: Demo2	Home Automation demo using Amazon Alexa voice interface to IBM Bluemix, controlling the IoT Starter Kit fitted with a relay output board plus LED matrix display I2C Pmod	15 min
12:30	Zentri	DMS: How to manage connected products	20 min
13:00	Hands-On: Lab3	DMS: Device Management exercise...	30 min
13:30	IBM	Node-RED and your Bluemix design	45 min
14:15	Hands-On: Lab4	Using Node-RED to integrate other IBM Bluemix services (eg. custom dashboard, email notifications, Cloudant DB storage)	90 min+

Installation + Sign-up Requirements

Installation and Account Sign-Up Instructions...

Website Registration requirements:

- **Zentri**: Sign-Up for a Zentri DMS Account
<https://dms.zentri.com/signup/>
- **IBM Bluemix**: Sign-up for your own **IBM Bluemix account**
<https://console.ng.bluemix.net/registration/>
- **Avnet**: Sign-Up to **CloudConnectKits** (access downloads and support forums)
<http://cloudconnectkits.org/user/register/>
- **Cypress**: Sign-up to **WICED Wi-Fi community forum** (optional / recommended)
<https://community.cypress.com/community/wiced-wifi>

Software Installation requirements:

- **ZentriOS SDK**: Download and install using this link:
http://resources.zentri.com/zentrios_sdk/ZentriOS_SDK_Installer.exe

Installation: JRE (Java Runtime Environment)



1) Zentri's Eclipse IDE requires that JRE is installed on your computer!

Recent version JRE 8 is recommended
- 32bit Windows: use 32bit JRE (**x86**)
- 64bit Windows: use 64bit JRE (**x64**)

2) Make sure the path to JRE is included within your Windows PATH

eg.

C:\ProgramData\Oracle\Java\javapath

Oracle Technology Network > Java > Java SE > Downloads

Products Solutions Downloads Store Support Training Partner

Overview Downloads Documentation Community Technologies Training

Java SE Runtime Environment 8 Downloads

Do you want to run Java™ programs, or do you want to develop Java programs? If you want to run Java programs, but not develop them, download the Java Runtime Environment, or JRE™.

If you want to develop applications for Java, download the Java Development Kit, or JDK™. The JDK includes the JRE, so you do not have to download both separately.

JRE 8u111 Checksum
JRE 8u112 Checksum

Java SE Runtime Environment 8u111

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

Accept License Agreement Decline License Agreement

Product / File Description	File Size	Download
Linux x86	54.86 MB	jre-8u111-linux-i586.rpm
Linux x86	70.65 MB	jre-8u111-linux-i586.tar.gz
Linux x64	52.75 MB	jre-8u111-linux-x64.rpm
Linux x64	68.57 MB	jre-8u111-linux-x64.tar.gz
Mac OS X	64.33 MB	jre-8u111-macosx-x64.dmg
Mac OS X	56 MB	jre-8u111-macosx-x64.tar.gz
Solaris SPARC 64-bit	46.04 MB	jre-8u111-solaris-sparcV9.tar.gz
Solaris x64	49.88 MB	jre-8u111-solaris-x64.tar.gz
Windows x86 Online	0.7 MB	jre-8u111-windows-i586-ftrv.exe
Windows x86 Offline	53.53 MB	jre-8u111-windows-i586.exe
Windows x86	59.43 MB	jre-8u111-windows-i586.tar.gz
Windows x64 Offline	60.31 MB	jre-8u111-windows-x64.exe
Windows x64	62.78 MB	jre-8u111-windows-x64.tar.gz

Oracle JRE Download site:

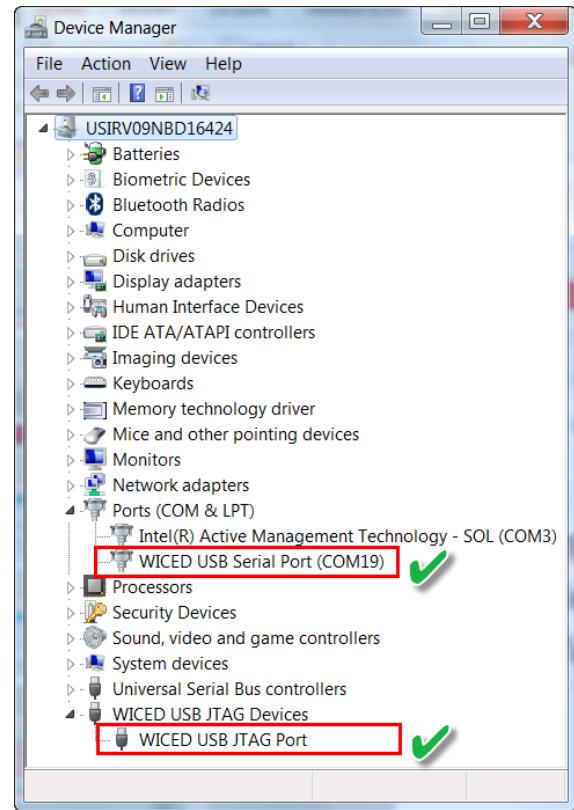
<http://www.oracle.com/technetwork/java/javase/downloads/jre8-downloads-2133155.html>

Installation: Manual USB Driver Install (not usually required!)

In some rare cases the USB drivers may require manual re-installation

This is done as follows:

- 1) Using Windows File Explorer go to:
...ZentriOS_SDK\tools\drivers\ATG002
- 2) Double-click **dpinst_x64.exe**
to run the **Device Driver Install Wizard**
(Use **dpinst32.exe** instead if your computer has an older 32 bit Windows installation)
- 3) Use Windows **Device Manager** to check the USB COM port and USB JTAG port are now reported correctly...



Download the Workshop Files...

<https://github.com/CloudConnectKits/WORKSHOP>

The screenshot shows a GitHub repository page for 'CloudConnectKits / WORKSHOP'. The URL in the browser address bar is highlighted with a red box. A yellow callout points to the address bar. The repository name 'CloudConnectKits / WORKSHOP' is displayed above the main content area. The main content area shows the repository details: 2 commits, 1 branch, 0 releases, and 1 contributor. A yellow callout points to the 'Clone or download' button, which is highlighted with a red box. The 'Clone or download' button has a yellow question mark icon above it. Below the repository details, there is a list of files and their commit history:

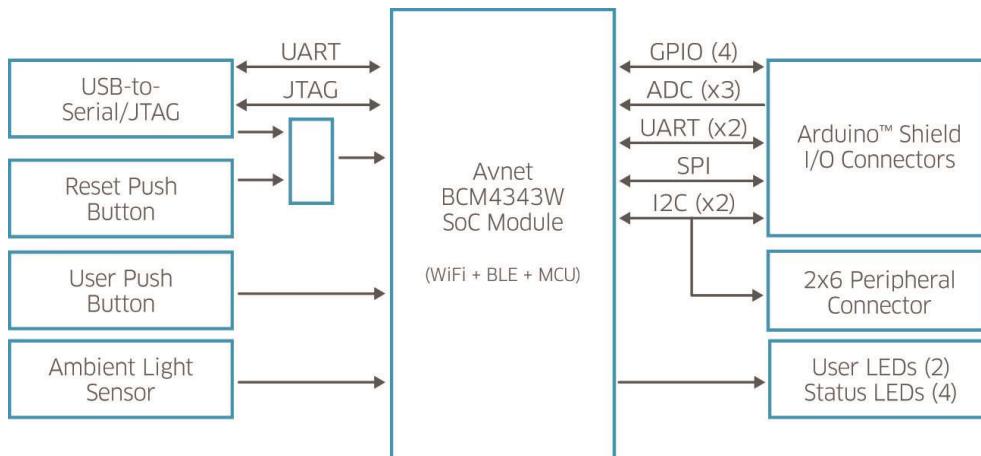
File	Commit Message	Time
Lab1	Add files via upload	a minute ago
Lab2	Add files via upload	a minute ago
Lab4	Add files via upload	a minute ago
README.md	Initial commit	an hour ago
teraterm-4.92.exe	Add files via upload	a minute ago

Avnet BCM4343W IoT Starter Kit

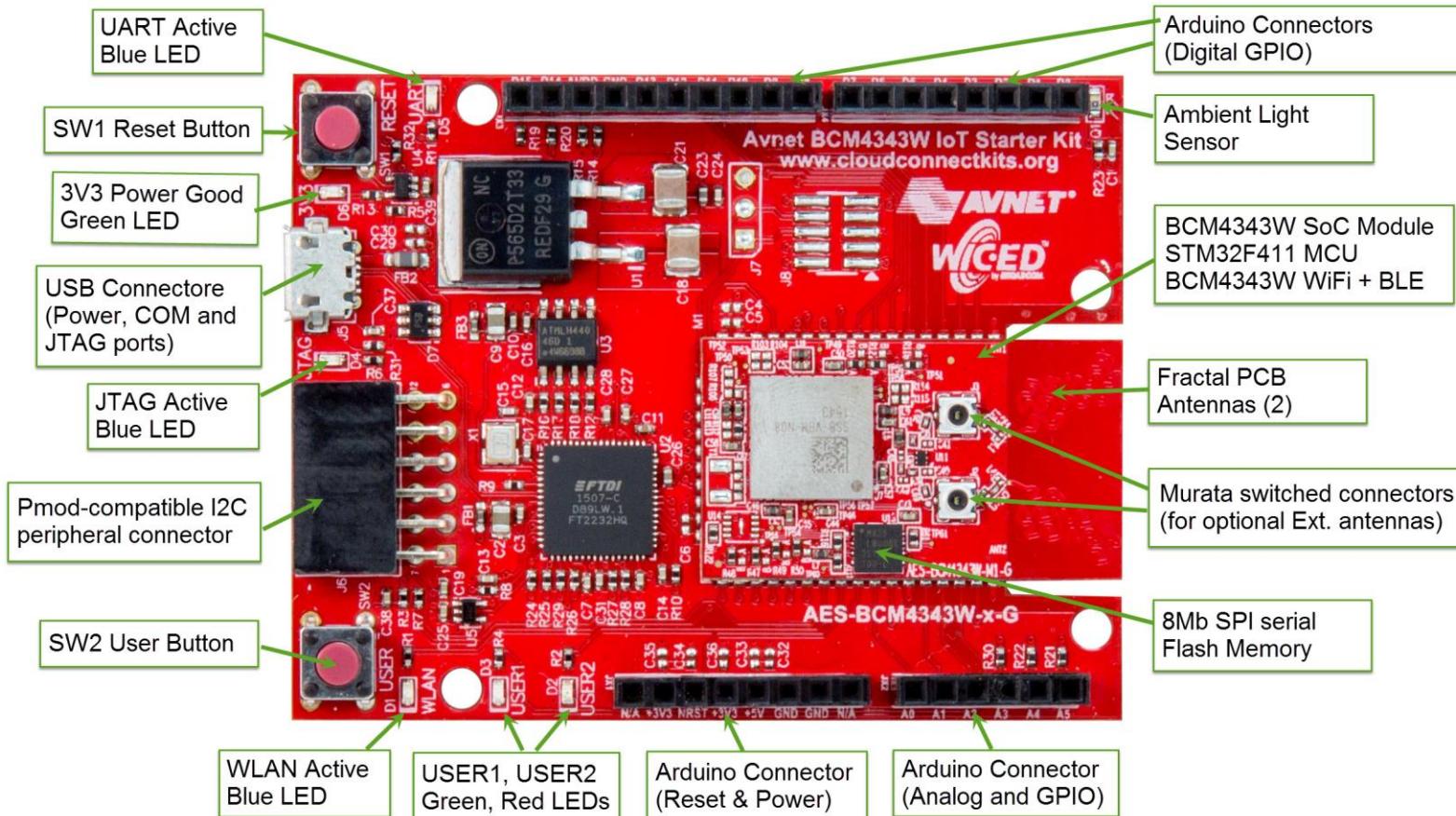


Avnet BCM4343W IoT Starter Kit

- Uses combo Avnet BCM4343W SoC Module
- WICED SDK and ZentriOS SDK support
- IBM Watson IoT and AWS IoT reference designs
- System expansion via:
 - Arduino™-compatible Shields,
 - Pmod™-compatible peripheral boards
 - BLE connected sensor boards...



Avnet BCM4343W IoT Starter Kit Detail



Why Choose Avnet BCM4343W IoT Starter Kit?

- **Low cost kit** (for production-ready module)
- **Industry leading partners**
 - Cypress : World's #1 Wi-Fi device manufacturer!
 - IBM Bluemix and AWS : Cloud-Services leaders!
- **Production ready module**
 - FCC, IC, CE, RoHS Certifications
 - Volume pricing
- **Simple prototyping**
 - Arduino™ and Pmod™ expansion connectors
- **Easy software development**
 - ZentriOS SDK or Cypress WICED SDK
- **Simple setup**
 - IBM Watson IoT (and AWS IoT) examples
- **Global support**
 - Avnet FAEs, Avnet supply chain

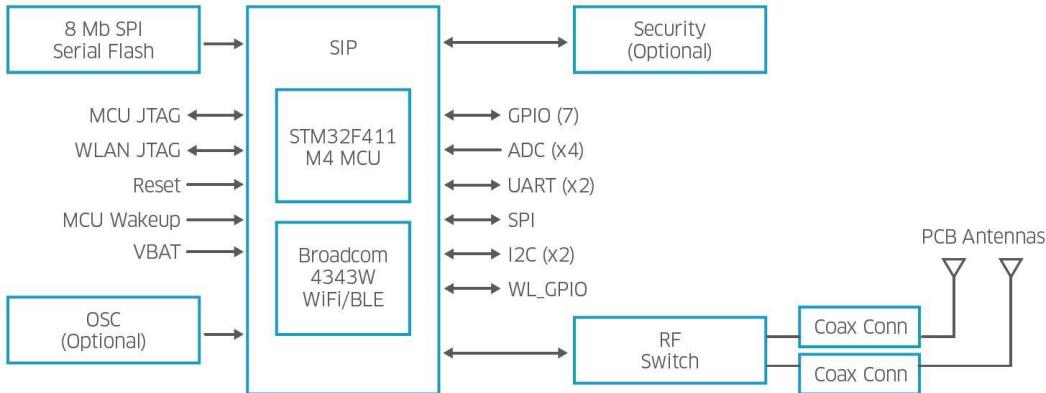


Avnet BCM4343W SoC Module



Avnet BCM4343W SoC Module

- Wi-Fi + BLE + MCU + SPI Flash SoC module
- 2.4GHz 802.11b/g/n and Bluetooth/BLE 4.1
 - Dual antennas for antenna diversity
 - PCB “fractal” antennas plus optional external antennas
- 44-pin LGA package for easy assembly (20 x 35 mm)
- Software Development using
 - **WICED SDK** (Cypress) or **ZentriOS SDK**



AES-BCM4343W-M1-G



Shipping Now!

Avnet BCM4343W SoC Module

- FCC, IC, CE, RoHS regulatory certifications
- Bluetooth SIG interoperability certification pending
- Technical documentation and reference designs provided
- Modules now shipping, volume pricing available
 - \$12.50 @ 1K (under \$10 at higher volumes!)
- Designs in USA, Europe, Asia in progress...



Online Support & Training Resources



Avnet CloudConnectKits.org Website

The screenshot shows the homepage of the Avnet CloudConnectKits.org website. At the top, there's a navigation bar with links for Home, Products, Buy, Forum, Sponsors, Sign in/Register, and a search icon. Below the navigation is a large banner featuring the Avnet logo and the text "Introducing the Avnet BCM4343W IoT Starter Kit". A red IoT starter kit board is shown prominently. Below the banner, a sub-section titled "Introducing the Avnet IoT" features a photo of hands holding the kit. Text in this section includes "Powered by Broadcom's WICED and Amazon Web Services" and "Simplifies connected device development and production with a certified wireless SoC module." There's also a "LEARN MORE" button.

The screenshot displays three pages from the Avnet CloudConnectKits.org website. The first page is a "Products" listing for the "Avnet BCM4343W IoT Starter Kit". It shows a thumbnail of the kit, a brief description, and a "VIEW PRODUCT" button. The second page is a "Discussion Forums" section. It has tabs for View Forums, Active topics, Unanswered topics, and New & updated topics. Below the tabs is a table of forums with columns for Topics and Posts. Several forums are highlighted with red boxes: "BCM4343W Starter Board Hardware" (12 topics, 31 posts), "BCM4343W Module" (15 topics, 41 posts), and "BCM4343W Starter Board Software" (47 topics, 202 posts). The third page is a detailed product page for the "Avnet BCM4343W SoC Module". It includes a thumbnail, a "Preliminary Product Information - Subject to Change" note, and a "Available for purchase 1st Quarter 2016" message. A "VIEW PRODUCT" button is at the bottom.

www.cloudconnectkits.org

- Product Info & Technical Docs
- Reference Designs
- Forum Support

BCM4343W IoT Starter Kit Online Training

<https://www.youtube.com/embed/AjVZJcxaEQk>

<https://www.youtube.com/embed/FkNtxAsljgl>

<http://cloudconnectkits.org/>

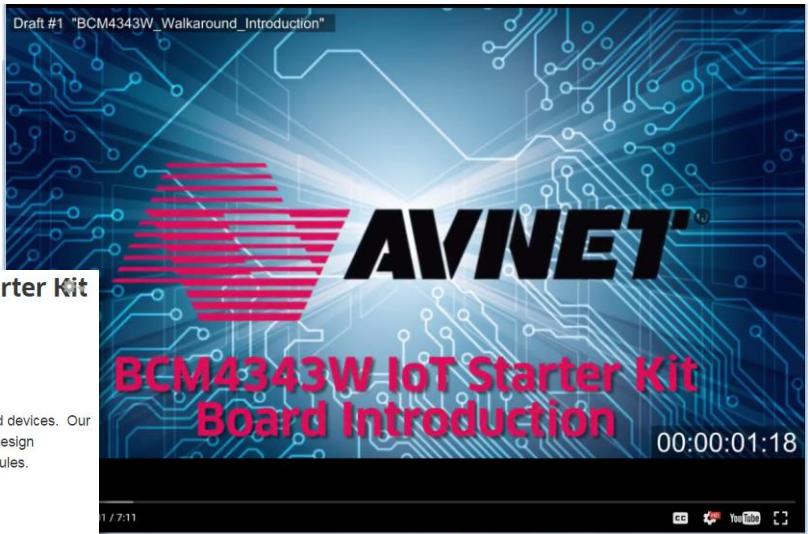


Introducing the Avnet BCM4343W IoT Starter Kit

Watch the video for a full kit overview.

About CloudConnectKits.org

Welcome to the site specifically targeting designers of cloud enabled, connected devices. Our goal is to provide you with the information, resources and support you need to design connected solutions based on our Cloud Connect Starter Kits and wireless modules.



Avnet IoT Starter Kit at Embedded World

David Armour (IoT Technologist with Broadcom) in EBV's booth at the 2016 Embedded World event, discussing the new AVNET BCM4343W IoT Starter Kit and Broadcom's WICED SDK development tools.



Software Development

ZENTRI



Cypress WICED...



WICED = Wireless Internet Connectivity for Embedded Devices

Wireless-Connectivity ICs

Highly integrated, robust,
widely deployed



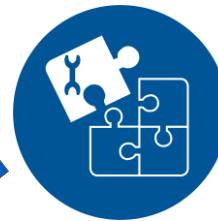
Partners

A global network
to productize IoT designs



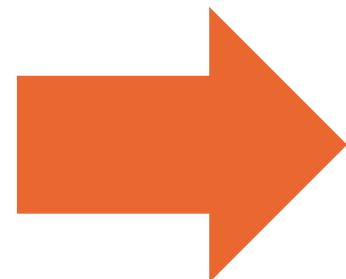
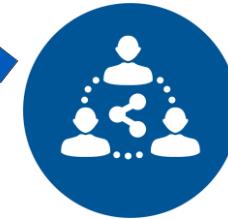
SDK

Fully-integrated, tested,
easy-to-use and free



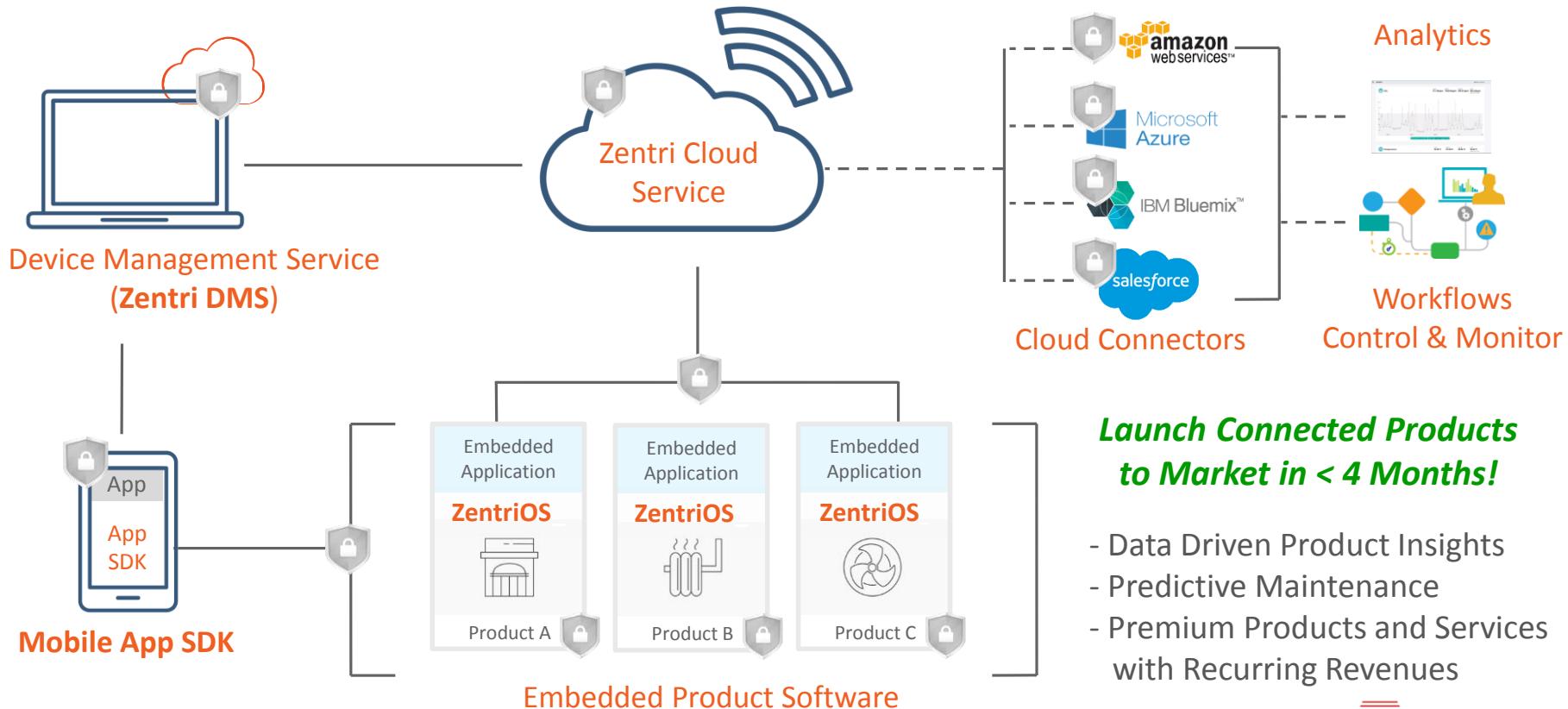
Community

20K+ Users
24x7 support from
Cypress engineers



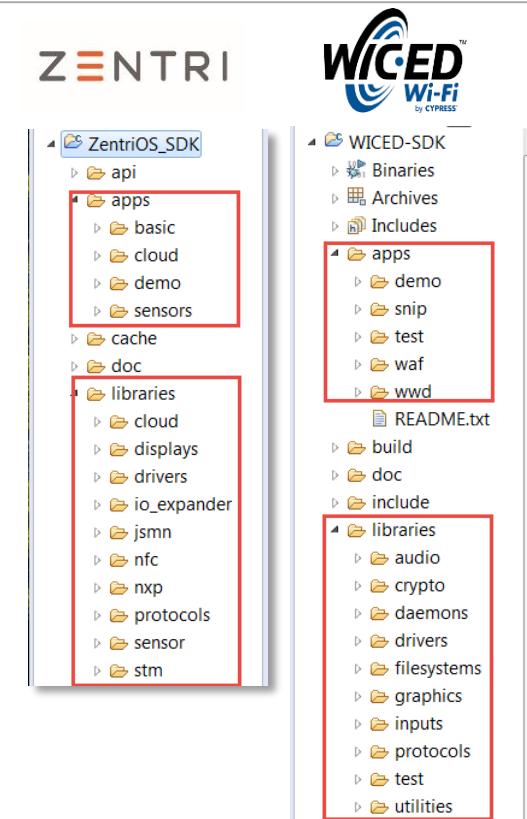
Zentri Product Ecosystem

ZENTRI



SDK Example Code and Device Drivers

- Both **ZentriOS SDK** and Cypress **WICED SDK** provide comprehensive examples, ranging from code-snippets to system-level application code
- Zentri provides enhanced functionality, including
 - support for specific I2C and SPI sensors, displays,etc
 - advanced cloud- and device management functions
- Additional Avnet reference designs available at:
<http://cloudconnectkits.org> and
<https://developer.ibm.com/recipes>



Sensor Boards

NXP MEMS Sensor Shield Detail

FRDM-STBC-AGM01 9-axis NXP sensor expansion “Shield” board featuring:

- **FXOS8700CQ**
3D Accelerometer ($\pm 2g/\pm 4g/\pm 8g$) and
3D Magnetometer
- **FXAS21002C**
3D Gyroscope

ZentriOS SDK includes drivers for both devices within the Zentri libraries

Zentri examples for these sensors include:

- **avnet_3d**
- **bluemix_nxp**



Cypress WICED Sense2 BLE Tag

Cypress WICED SMART BLE SoC plus four STMicro sensors and a coin-cell battery



BCM20737L BLE SoC



L5M6D3 Gyro and Accelerometer



LIS3MDLTR eCompass



LPS25HBTR Pressure sensor



HTS221 Humidity and Temperature sensor



iPhone App UI



Zentri: ZentriOS and SDK: How to build connected products (30 min)

ZENTRI

IoT Components



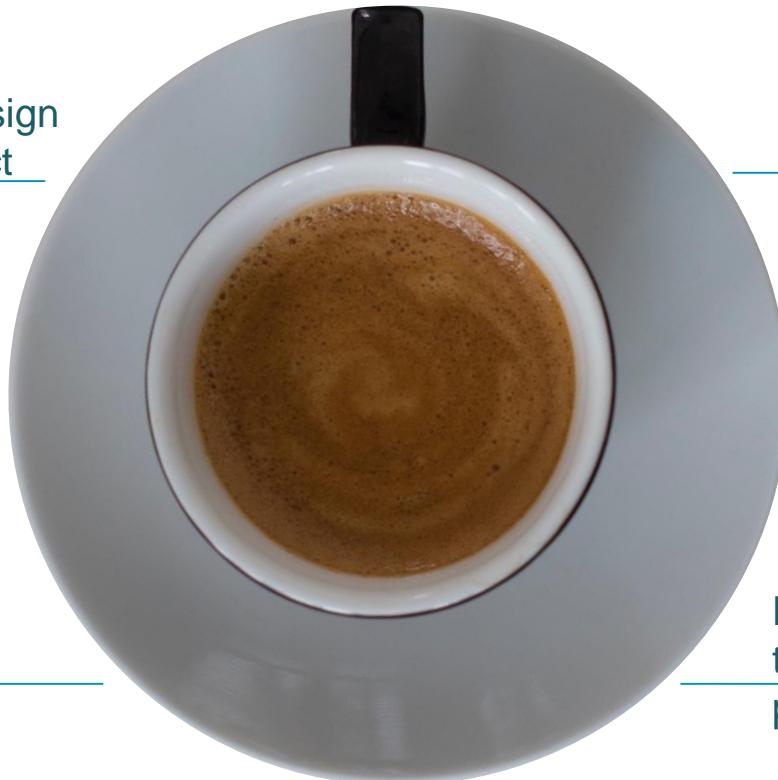
Product Journey



Select hardware; Design & develop the product



Connect to cloud vendors and analyze data



Develop rich user/mobile app



Deploy & manage the connected products



BUILD OR BUY



Start from scratch or develop on a platform

Embedded Design – Firmware Approach

Native (Build)

- Smallest footprint
- Long design cycles
- Complex development
- Difficult to manage
- New features
 - not easily available

Agent (Neither)

- New features
 - not easily available
- Designed to enable a single cloud solution
- Difficult to manage
- May drive poor future decisions through cloud lock-in

IoT Operating Systems (Buy)

- Most flexible option
- New features and capabilities
- Focus on what matters
 - your application
- Designed for management

Product Journey



Select hardware; Design
& develop the product



Connect to cloud
vendors and analyze
data

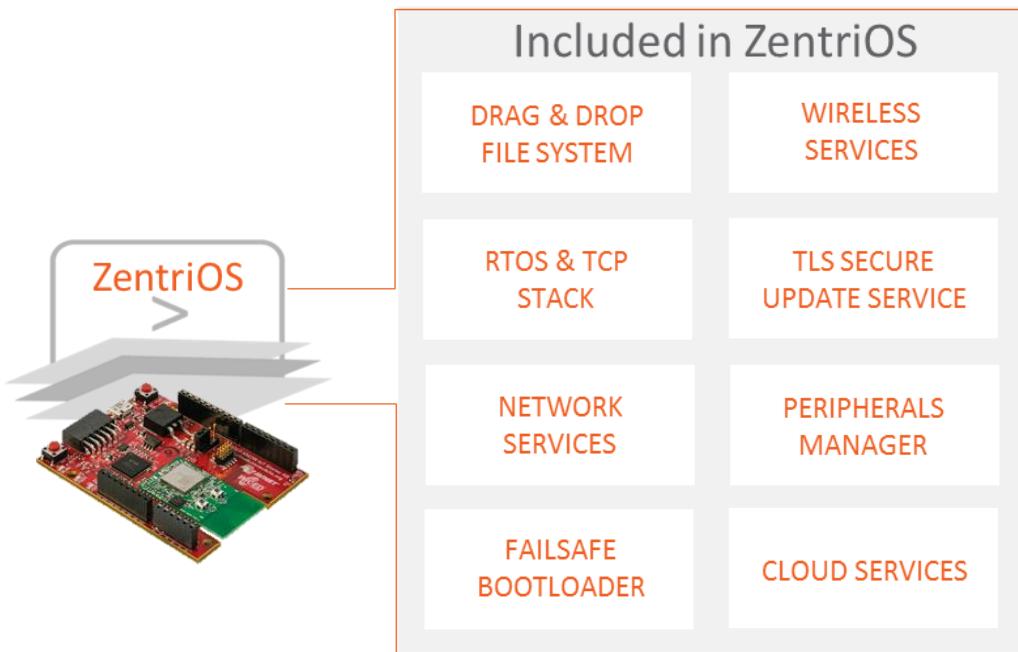


Develop the a rich
user/mobile app



Deploy & manage
the connected
products

Embedded Design - ZentriOS



- Reduces design effort by approximately 90%
- In-built security
- Designed for the low cost sensor, command & control, IoT market
- Designed for ARM Cortex M3/M4 Microcontrollers

Your Options : Building an IoT Product with ZentriOS

App runs on Host MCU



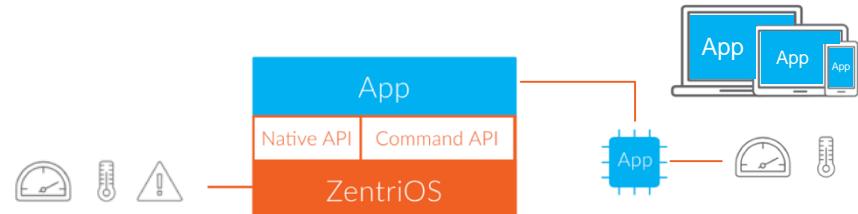
App runs on wireless Mobile/PC



App runs on ZentriOS Module



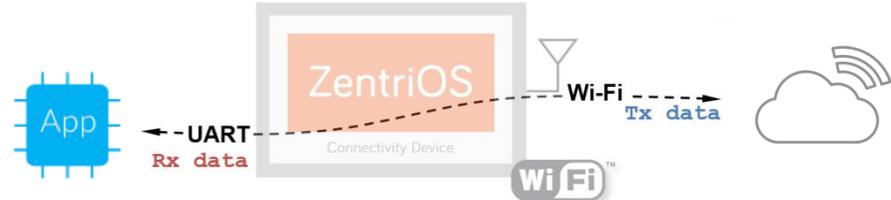
Hybrid App



ZentriOS Command API

Simple Streaming

- After setup, a ‘simple’ host controller can securely stream data between serial bus and network/cloud
- No need for controller to issue commands, however the Command API still accessible
- Streaming data between serial bus and WebApp possible via WebSocket



AND / OR

Extensive Command Set

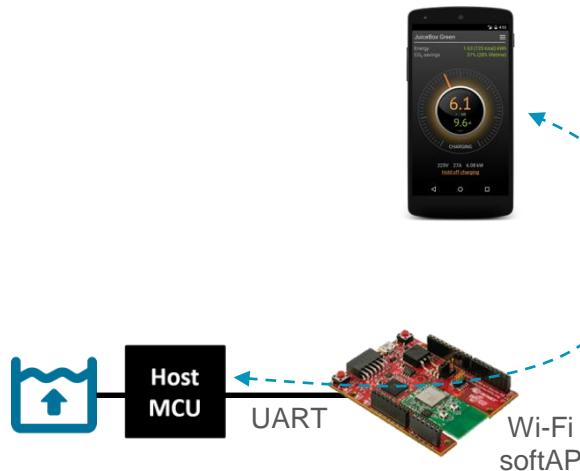
- Provide access to network & cloud services, peripherals, file system, +
- Accessible via serial interfaces, remote terminal (Telnet), REST API
- Host controllers include MCUs, Web browsers, Mobile Apps, PC Apps, etc.



ZentriOS Use Cases - Streaming

Water Level Meter

Simple MCU streams stored water level logs to a mobile app (via a softAP)



PC Printer

PC prints to a label printer using a RAW TCP print driver. ZentriOS transparently passes print data.



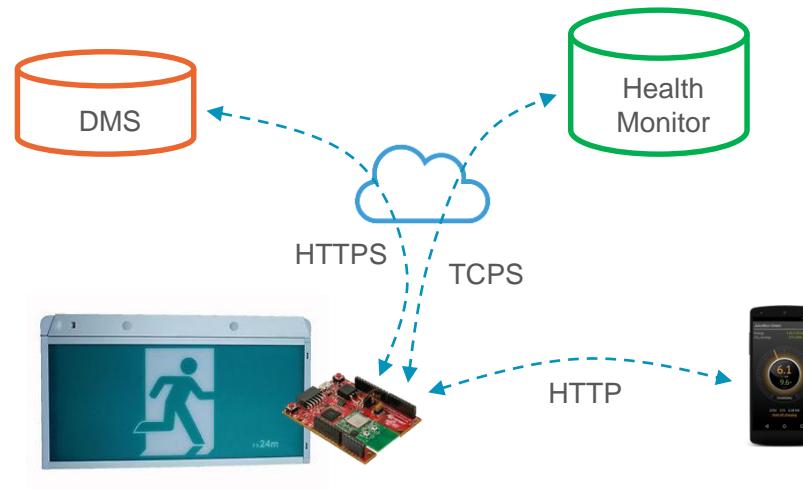
ZentriOS Use Case Example for Commands

Exit Sign

- Firmware updates & telemetry via ZentriDMS
- Monitor battery health, building temperature, light levels, etc.
- Local configuration via Webapp

Example Commands

```
set tls.client.host  
tls_client  
write "voltage=12.23"  
get time.uptime  
ota  
...
```



ZentriOS Command API Examples

```
> wlan_scan
! 9 networks found
!   # Ch RSSI MAC (BSSID)      Network (SSID)
# 0 1 -78 2C:B0:5D:31:6F:6A button
# 1 1 -89 28:C6:8E:70:93:18 Philips Home Network_EXT
# 2 6 -32 B2:7F:B9:6B:AA:90 Vodafone Air
# 3 6 -33 B2:7F:B9:6B:AA:91 Fon WiFi
# 4 6 -33 B0:7F:B9:6B:AA:9E kc-express
# 5 6 -83 10:0D:7F:E5:1A:61 VD3B082C8
# 6 8 -86 C0:FF:D4:CC:69:30 KILLEATON
# 7 11 -44 84:1B:5E:29:9D:F7 NETGEAR06
# 8 11 -89 30:B5:C2:FA:0F:29 TP-LINK_OF29
```

```
> ls
!   #   Size   Version   Filename
# 0    7578   3.2.0   .recovery.html
# 1   44560   3.2.0   command_help.csv
# 2   7750   1.0.0   default_config.csv
# 3    135   3.2.0   default_setup.script
# 4     721   3.2.0   favicon.ico.gz
# 5   1236   3.2.0   geotrust_ca.pem
# 6  212736   3.2.0   sys/kernel.bin
# 7  175832   3.2.0   sys/services.bin
# 8    1995   3.2.0   webapp/index.html
# 9   9530   3.2.0   webapp/unauthorized.html
```

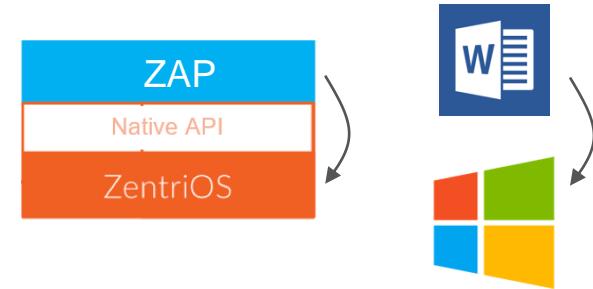
```
> http_get https://google.com
0
> read 0 500
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en-AU"><head>
<meta content="text/html; charset=UTF-8"
http-equiv="Content-Type">
<meta content="/images/branding/googleg/1x/googleg_standalone_color_128dp.png" itemprop="image"><title>Google</title><script>(function() {window.google={kEI:'MNwKWOz7IIXA0gSp97f4Ag', kEXPI:'750721,1351633,1351902,3700273,3700400,4029815,4031109,4032678,4036527,4038012,4039268,4040137,4043492,4045841,4048347,4052304,4058720,4062186,4064493,406578}
```

```
> gpio_direction 14 out
Set OK
> gpio_set 14 1
Set OK
> get gpio.usage
!   # Description
# 5 system.indicator.wlan
# 6 SPI0 MISO
# 7 SPI0 CLK
# 8 SPI0 MOSI
# 11 UART0 RX
# 12 UART0 TX
# 13 system.indicator.network
# 14 GPIO out
```

ZentriOS Native API & ZentriOS Apps (ZAPs)

Native Applications

- Run custom applications on ZentriOS (ZAPs)
 - Analogy: MSWord running on Windows®
- Provides programmatic access to ZentriOS APIs
- Command/Stream modes still 100% accessible



ZAP Use Cases

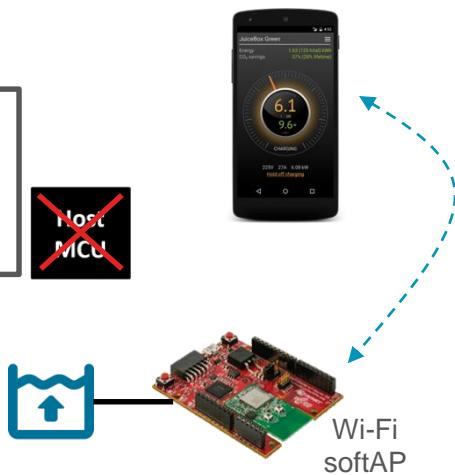
- Customize ZentriOS: A ZAP may extend or override ZentriOS commands
- Remove host MCU from BOM and implement logic in ZAP
- Package data from 'simple' host controller before sending to cloud
- Log sensor data to flash and read log files later using a WebApp

ZentriOS App (ZAP) Use Cases

Water Level Meter

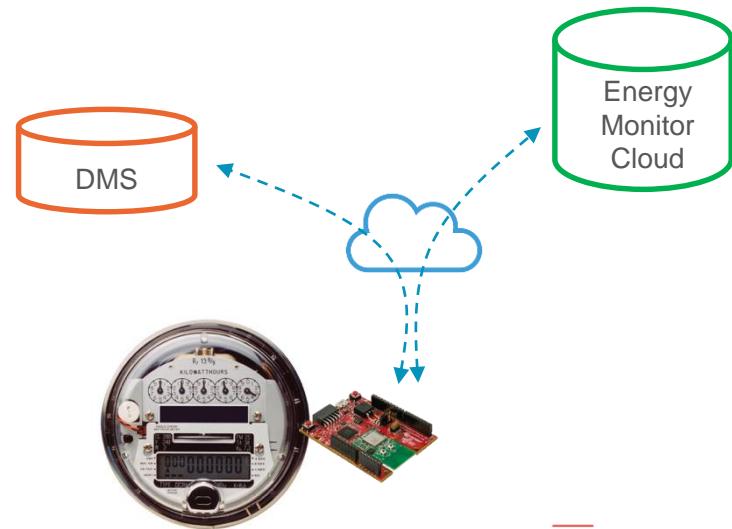
ZAP takes water level samples and stores to ZentriOS file system. Transfers to mobile via a softAP.

No MCU
Needed



Energy Monitor

ZentriOS connects via I2C to an energy meter and sends energy data to the cloud.



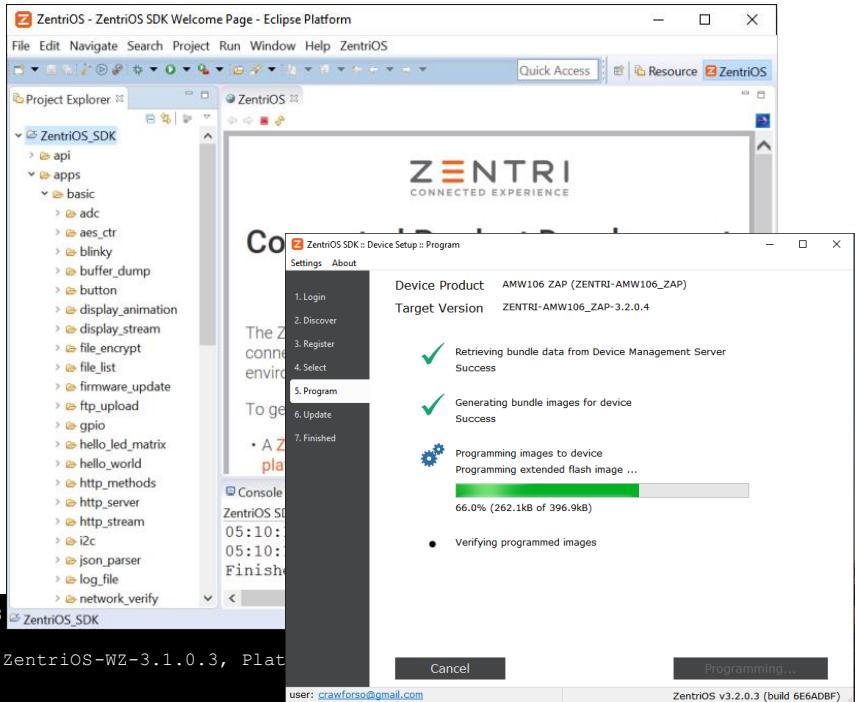
ZentriOS Applications (ZAPs) – Under the hood

- Written in native C
- Complete access to ZentriOS API and MCU registers
- Securely updated along with ZentriOS via OTA
- Uniquely encrypted per device (more on this in later)
- Event driven architecture
- Multiple contexts in which to execute events

ZentriOS SDK – Writing the ZAP

- Command line or UI driven
- GCC tool-suite
- Thread-aware, single-step debugger (GDB) with hardware breakpoints
- Eclipse IDE with SDK plugin
- Lots of Example Apps
- Release firmware to DMS

```
C:\ZentriOS_SDK>make basic.blinky-AVN4343
Making config file for first time
SDK Version: 96DFAC76, ZentriOS Version: ZentriOS-WZ-3.1.0.3, Plat
Compiling app_basic_blinky
Compiling Platform AVN4343
Compiling Zentri_Platform_Common
Making basic_blinky-AVN4343.elf
Optimizing Application ...
```



Example ZAP – Button & LEDs

```
#include "zos.h"

void zn_app_init(void) // Initialise the ZAP
{
    ZOS_LOG("Button1 - GPIO%d", PLATFORM_BUTTON1);
    ZOS_LOG("LED1    - GPIO%d", PLATFORM_LED1);
    ZOS_LOG("LED2    - GPIO%d", PLATFORM_LED2);

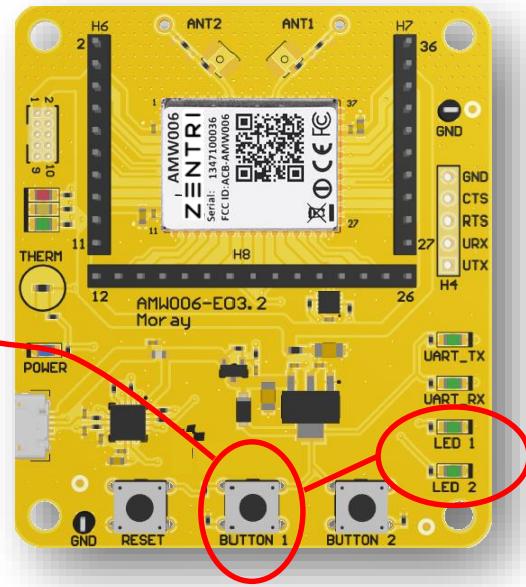
    zn_gpio_init(PLATFORM_BUTTON1, GPIO_INPUT_HIGHZ, 0);
    zn_gpio_init(PLATFORM_LED1, GPIO_OUTPUT_PUSH_PULL, 0);
    zn_gpio_init(PLATFORM_LED2, GPIO_OUTPUT_PUSH_PULL, 0);

    zn_gpio_irq_enable(PLATFORM_BUTTON1, GPIO_IRQ_TRIGGER_BOTH_EDGES,
                       my_gpio_irq_callback, (void*)PLATFORM_BUTTON1);
}

static void my_gpio_irq_callback(void *arg) // Executes inside the GPIO hardware IRQ
{
    const zos_gpio_t button_gpio = (zos_gpio_t)arg;
    const zos_gpio_t led_gpio = (button_gpio==PLATFORM_BUTTON1) ? PLATFORM_LED1 : PLATFORM_LED2;

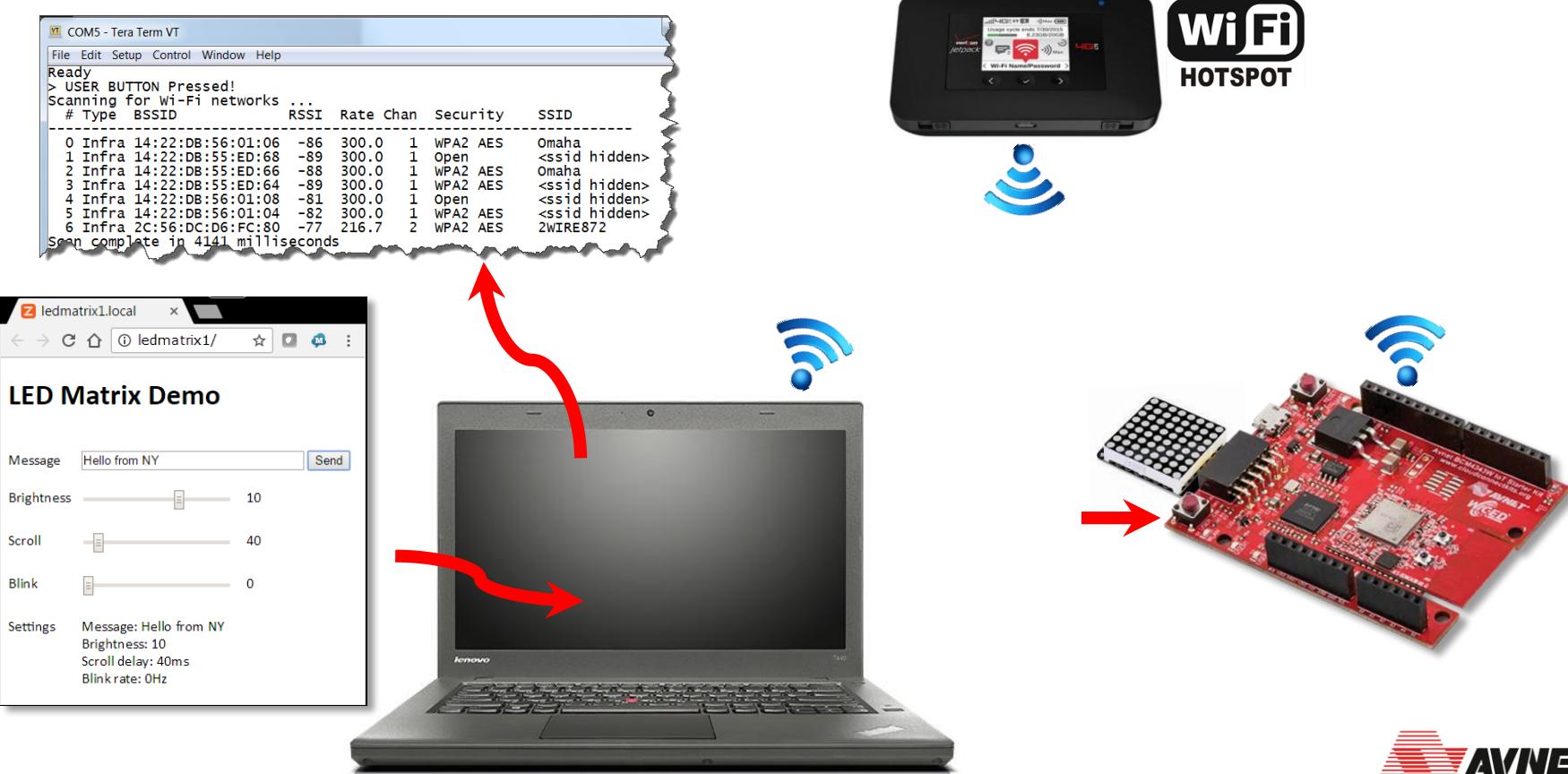
    const zos_bool_t value = zn_gpio_get(button_gpio);
    zn_gpio_set(led_gpio, value);
}

zos_bool_t zn_app_idle(void)
{
    // Return true so the event loop sleeps
    return ZOS_TRUE;
}
```



Workshop Lab 1

Lab 1 - System Diagram



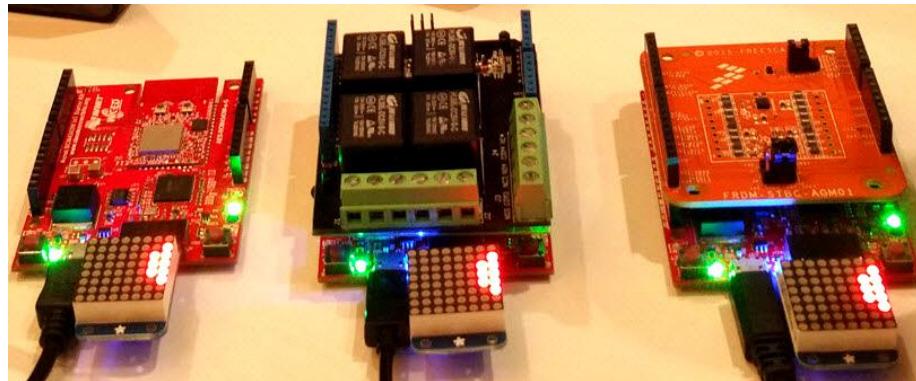
Lab 1 - Objectives

- Get to know the **Avnet BCM4343W IoT Starter Kit**
- Explore **code examples** in Zentri SDK **apps** folders
- Explore Zentri SDK **library functions** for peripheral interfaces plus drivers for specific devices
- Import Lab 1 project based on Zentri **led_matrix** example, to which **button** and **scan** example code (from **basic** folder) has been added



Lab 1 - Objectives

- **Build, Download and Run** the modified `led_matrix` example app to:
 - implement an http server based user interface
 - update this webpage in response to remote user input
 - communicate over I2C with 8x8 LED display peripheral
 - execute user-button triggered scans for Wi-Fi Access Points
 - output formatted results from the Wi-Fi scans to the serial console
- **Have some fun** creating scrolling custom LED matrix messages!



Lab 1 - Results...

- Dynamically updated http web server implemented on module (accessed via Wi-Fi)
- User control of:
 - Message Content (on the fly by user entry into text-box...)
 - Brightness of LEDs (level 0-15)
 - Scrolling Delay (10 - 400 ms)
 - Blink Rate (0 - 0.5 Hz)
- Pushbutton triggered Wi-Fi scans
- Wi-Fi scan results on serial console



Workshop Lab 2

Lab 2 – System Diagram

IBM Watson IoT Platform Quickstart webpage charting of:

- Light Sensor and Wi-Fi RSSI measurements
- 9-axis of motion & orientation measurements from NXP Sensor Shield

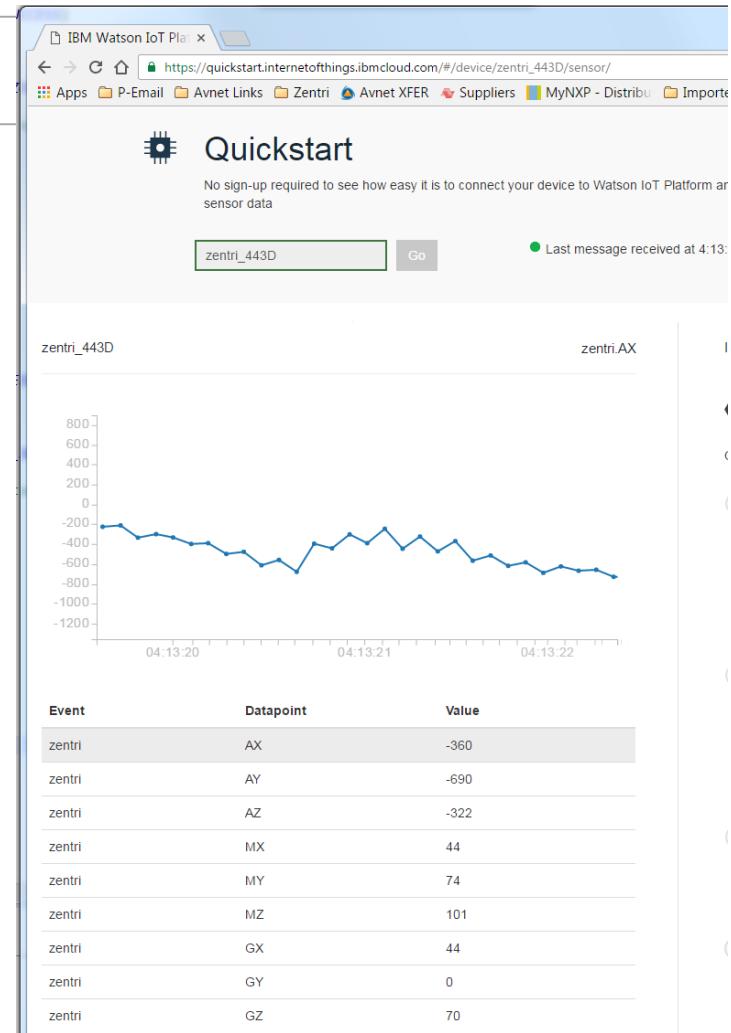


Lab 2 - Objectives

- Implement MQTT over Wi-Fi communication between your board assembly and the IBM Watson IoT broker
- Periodically sample and publish to Watson IoT QuickStart webpage the light sensor levels, Wi-Fi RSSI, plus motion & orientation measurements from an NXP Sensor Shield)
- Exercise the Watson IoT QuickStart webpage user interface

Lab 2 - Results...

- Note changes in the Accelerometer, Gyro and Magnetometer outputs in response to the board's motion and orientation
- Cast a shadow on the light sensor (or illuminate it using the flashlight function of your Smartphone) and observe changes in the charted light sensor values
- Shield your hand over the antennas of the wireless module and note the attenuation of the charted Wi-Fi RSSI values



Workshop Demo1



Demo 1



Cypress Sense2 BLE to Watson IoT Demo

Cypress Sense2

BLE Tag



iOS / Android Device
(Wi-Fi Provisioning)

IBM Watson IoT Platform



***Instructor-led demo** using WICED Sense2 BLE Tags
(Reference Design source code available to attendees for use after workshop...)

ble2bluemix – Configuration of Bluemix Parameters

Organization ID	j87k20
Device Type	ZentriDevice
Device ID	zentri_4432
Authentication Method	token
Authentication Token	eZaSfvR@G9M@u3sX_z

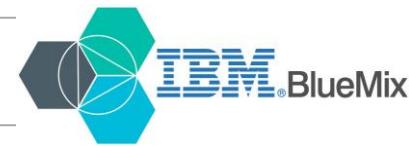
get bluemix

bluemix.device_id	zentri_4432
bluemix.device_token	eZaSfvR@G9M@u3sX_z
bluemix.device_type	ZentriDevice
bluemix.org_id	j87k20

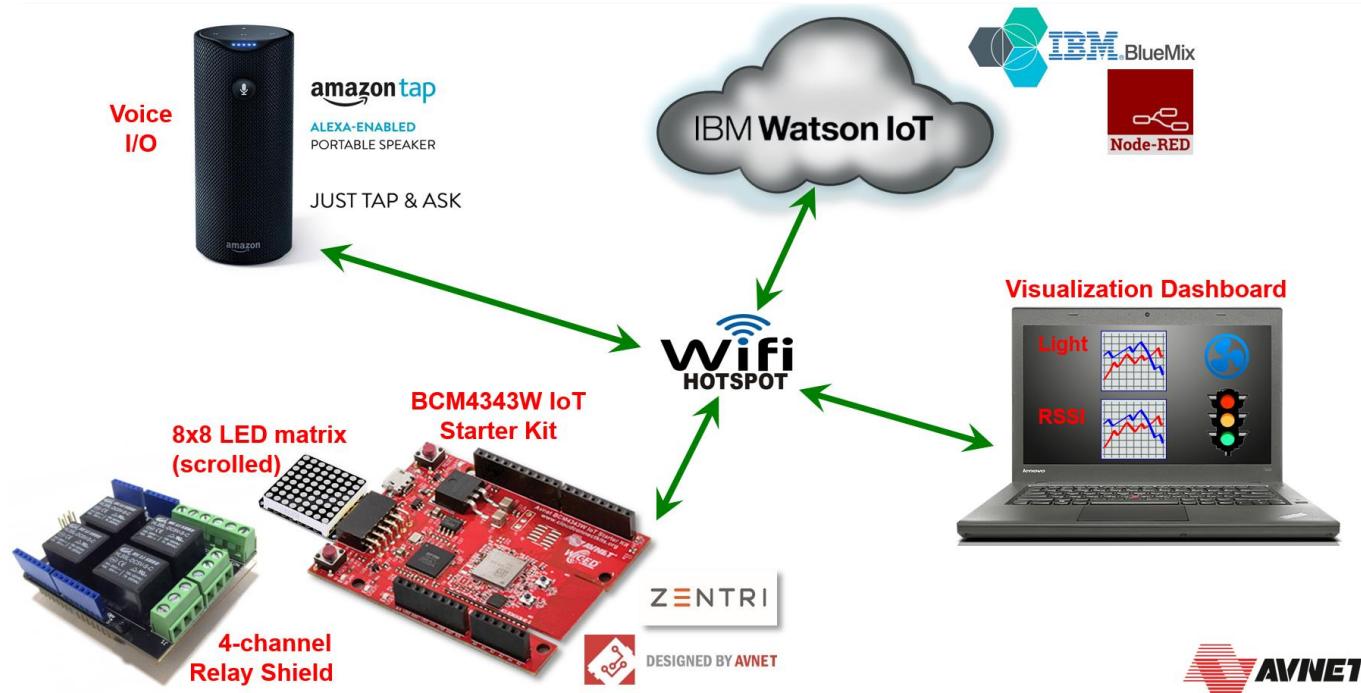
Workshop Demo2



Demo 2



Alexa Voice Home Automation Demo



*Instructor-led demo using Amazon Tap (Alexa voice interface) to IBM Bluemix services
(Reference Design source code available to attendees for use after workshop...)

Zentri: DMS

How to manage connected products (30 min)

ZENTRI

Product Journey



Select hardware then
design & develop the
product



Connect to cloud
vendors and analyze
data



Develop the a rich
user/mobile app



Deploy & manage
the connected
products

Often overlooked but vitally important

"Isn't device management just a fancy phrase for 'firmware updates'?"



Why IoT is Transforming Products

IoT is not just ...

- Hype
- Connectivity
- A new word for M2M



It is a way to ...

- Be closer to the customer
- Get real-life analytic data on a product
- Obtain recurring revenue via updates
- Perform remote diagnostics
- Improve efficiency & minimize costs
- Enable innovation
- Increase product agility
- Transform a stagnant business model

DMS delivers these outcomes.

The Most Successful IoT Companies Use Device Management



Product Journey Without Device Management



- New features require new unit/design
 - SKU is never updated
 - Customization = new SKU
- Product feedback – was it successful?
 - Expensive focus groups, surveys, recalls, online forums, consumer reports, truck rolls, etc.
- Customer relationship ends with the sale



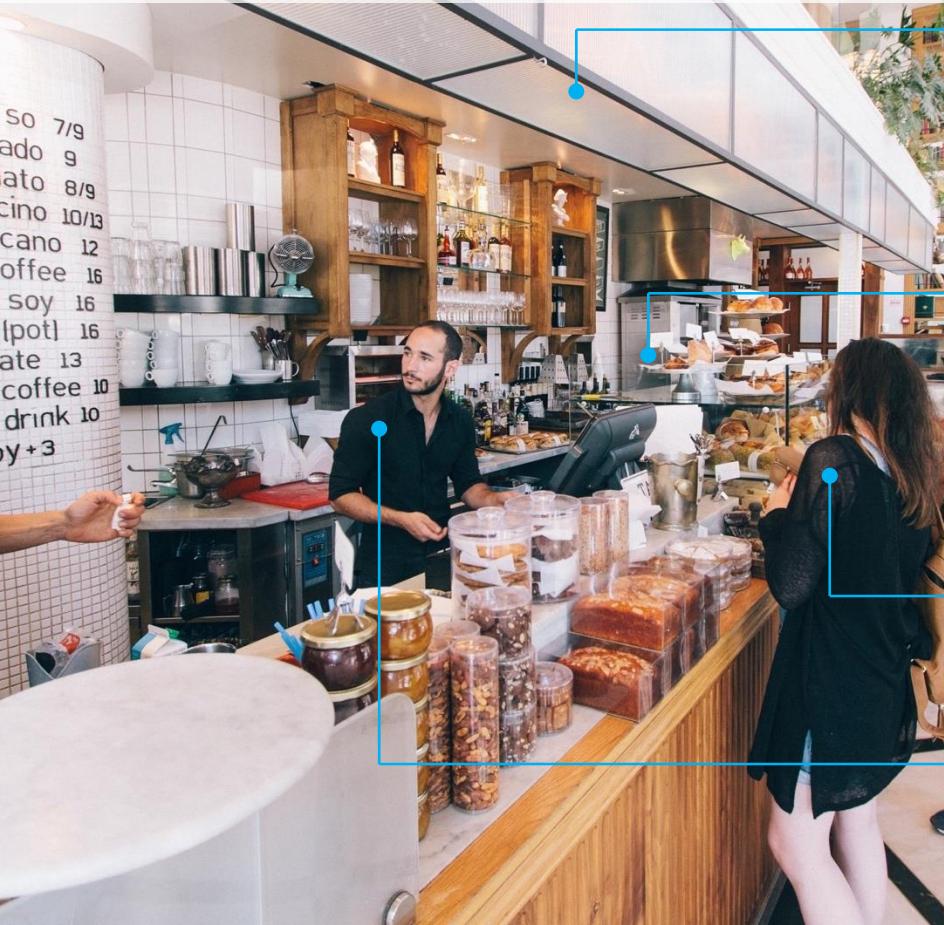
Product Journey With Device Management



- New features from software updates
 - Same SKU
 - Customers can opt-in (no new COGS)
- Product feedback
 - Instant product usage data
 - Data from device to product teams
- On-going customer engagement through apps



Benefits for All



Coffee Shop Chain (Dunder-Mifflin Coffee)

1. Asset management and compliance
2. Feature enablement/management
3. Reduced operating costs
4. Improved customer loyalty

Manufacturer (Mr. Coffee)

1. Real-time insights
2. New features without new SKUs
3. Recurring revenue/new services to offer
4. Custom firmware (app store)
5. Business logic customization

Coffee Customer (Pam)

1. Shorter lines through automation
2. Convenience through apps

Coffee Store Manager (Michael Scott)

1. Improved maintenance & support
2. Improved customer service

Tesla Security and DMS

Tesla had vulnerabilities in the Tesla Model S that would have allowed someone to start the Tesla Model S with a software command from a laptop.

WIRED

How the Internet of Things Got Hacked

SHARE



SHARE

57



TWEET



PIN



COMMENT

25



EMAIL

That Jeep attack turned out to be only the first in a series of car hacks that rattled the auto industry through the summer. At the DefCon hacker conference in August, Marc Rogers, principal security researcher for CloudFlare, and Kevin Mahaffey, co-founder and CTO of mobile security firm Lookout, revealed a suite of vulnerabilities they found in the Tesla Model S that would have allowed someone to connect their laptop to the car's network cable behind the driver's-side dashboard, start the \$100,000 vehicle with a software command, and drive off with it—or they could plant a remote-access Trojan on the car's internal network to later remotely cut the engine while someone was driving. Other vulnerabilities they found could theoretically have been exploited remotely without needing physical access to the car first, though they didn't test these. Tesla patched most of these in an over-the-air patch delivered directly to vehicles.

Tesla patched most of these in an over-the-air patch delivered directly to vehicles.

Deciding Your Security Path

STEP 1

Recognize the vulnerabilities and new skill sets required from connected products.

STEP 2

Assess options:

1. No Security
2. Some Security (encrypted data-at-rest & data-in-motion)
3. End-to-End Security (Encrypted data-at-rest, data-in-motion & application with unique device IDs, etc.)

STEP 3

Rest easy or accept the consequences

Most Common Reasons for Skimping on Security

Lack of Education

Connected products require far more security than non-connected products; they don't know what they don't know

Avoidance

Security can add complexity to a product, increasing support calls so manufacturers opt to avoid it

Time-consuming

Security can delay product launch; it's very time consuming

Costly

Security specialists are expensive and required for long spans of time

Misconceptions

Misconception that security can be easily added post-launch

HACKERS REMOTELY KILL A JEEP ON THE HIGHWAY—WITH ME IN IT

Slashdot

Stories

Firehose >

All

Popular

Polls

Deals

Submit

NEWS

Technology

Nissan Leaf electric cars hack vulnerability disclosed



Search CNET



Reviews

News

Video

How To

Deals

Download

Log In / Join

US Edition

Entertainment Technology Open Source Science YRO

They Hacked and Spoofed (cybergibbons.com)



123

CNET > Appliances > Smart Home > Light Bulbs > Hackers find security weaknesses with the Lifx smart LED

Hackers find security weaknesses with the Lifx smart LED

A team of British security consultants hacked their way into a private Wi-Fi network – using Lifx bulbs as the backdoor.

Forbes / Security

FEB 17, 2016 @ 10:27 AM

16,943 VIEWS

300,000 American Homes Open To 'Unfixable' SimpliSafe Alarm



The Little Black

U.S.

HOME BUSINESS MARKETS WORLD POLITICS TECH OPINION BREAKINGVIEWS MONEY LIFE PICTURES VIDEO

SIGN IN | REGISTER



Search Reuters



All at sea: global shipping fleet exposed to hacking threat



NEWS

EVENTS

The Daily Dot

THE KERNEL

TOPICS



The IoT is the Internet of Easy Home

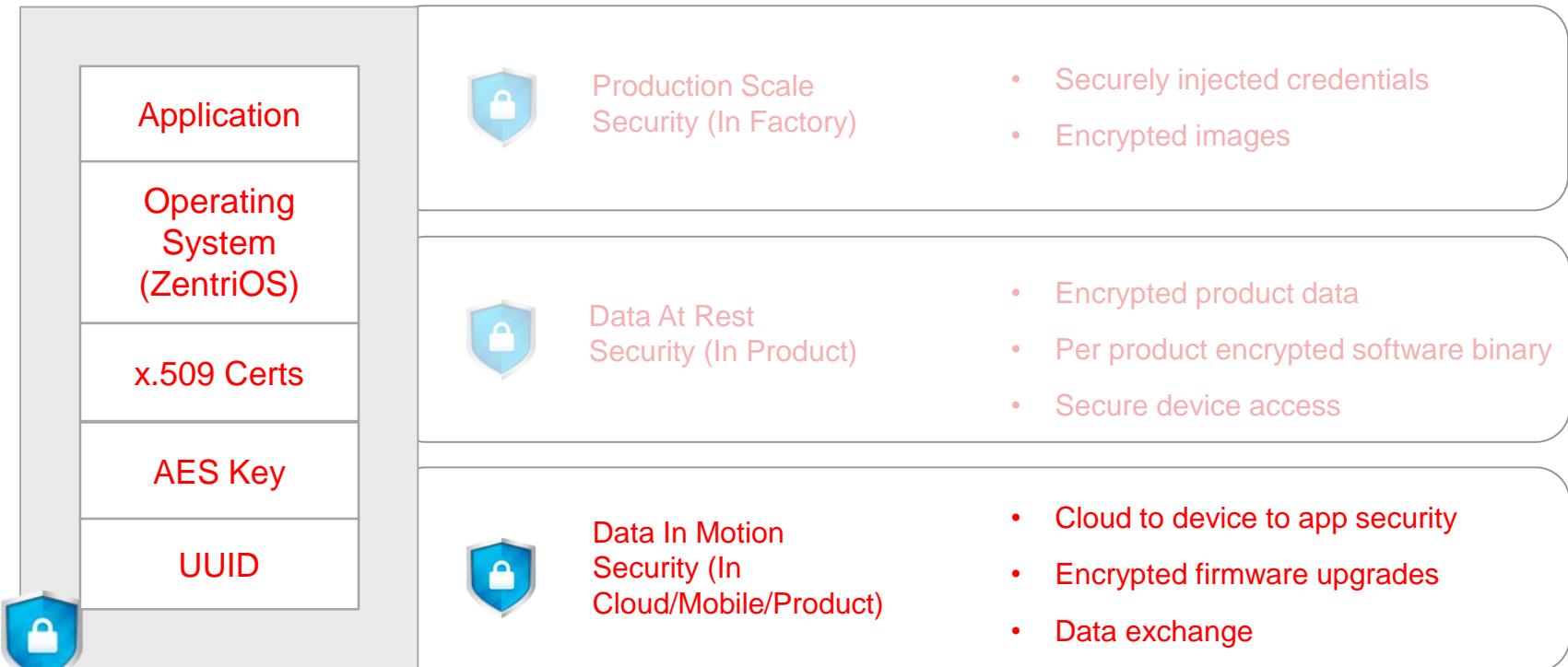


Tech
This \$32 gadget can steal your garage door code and hack your car locks



Security Done Right

- Security is expensive and inconvenient, but more so if you don't do it correctly or don't do it at all



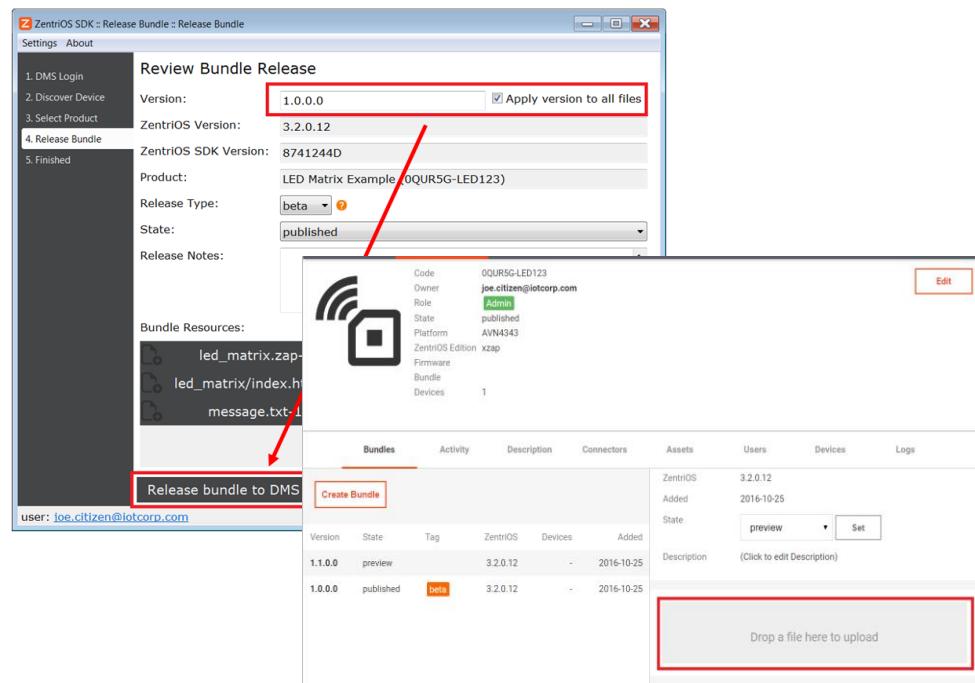
Zentri: Lab 3 - DMS (30 min)

ZENTRI

Lab 3 – Release & Deploy using ZentriOS & Zentri DMS

Learning Objectives

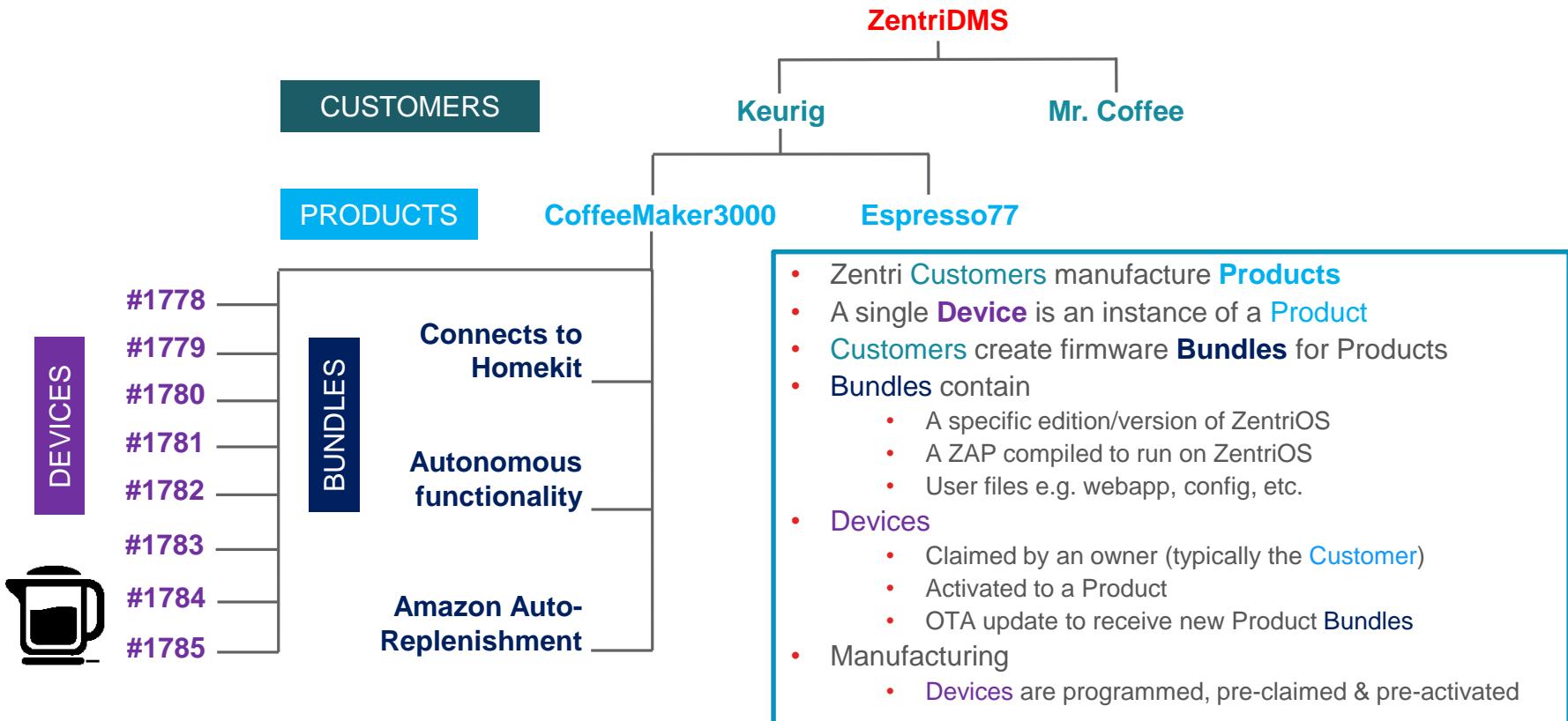
1. Understand DMS Terms
2. Create a Product on the DMS
3. Build & Release a firmware bundle for the Product
4. Clone the bundle on the DMS
5. Modify the Bundle
6. OTA update your Avnet board with the new bundle



DMS Lab Overview – 30 mins

- 5 mins – Intro DMS key concepts & terms
- 5 mins – Walkthrough DMS pages
- 10 mins – Use SDK to build, test, release a ZAP to DMS
 - ZAP prints some text read from a file on the file system
- 10 mins
 - See the app on the DMS
 - Clone the bundle, upload a new text file
 - OTA the to the device
 - Show the new text prints now (instead of the released text)

ZentriDMS Terminology



Lab 3 –Zentri DMS Device Management Service

The image displays three separate browser windows showing the Zentri DMS interface:

- Left Window (Dashboard):** Shows a world map with several red dots indicating device locations. The top navigation bar includes "Devices", "Products", "Dashboard", and "Support".
- Middle Window (Products):** Shows a list of products. A "Create Product" button is at the top. Two items are listed:
 - Turbulence Monitor** (Code: OEMJCA-TM2455)
 - AMW106 ZAP** (Code: ZENTRI-AMW106_ZAP)Each item has columns for Platform (AMW106), Flavor (zap), and Bundle (version).
- Right Window (Product Details):** Shows the details for the "Turbulence Monitor" product. It includes a large icon, title, code, and a "Edit" button. Below is a table for "Bundles":

Bundles	Connectors	Assets	Logs	1.0.0.0	Edit
Version	State	Tag	ZentriOS	Added	
1.0.0.0	published	release	3.0.0.13	2015-11-30	
tm_webapp.html					
MISC_FIXED_LENGTH					
turbulence_monitor.zap					
ZAP					

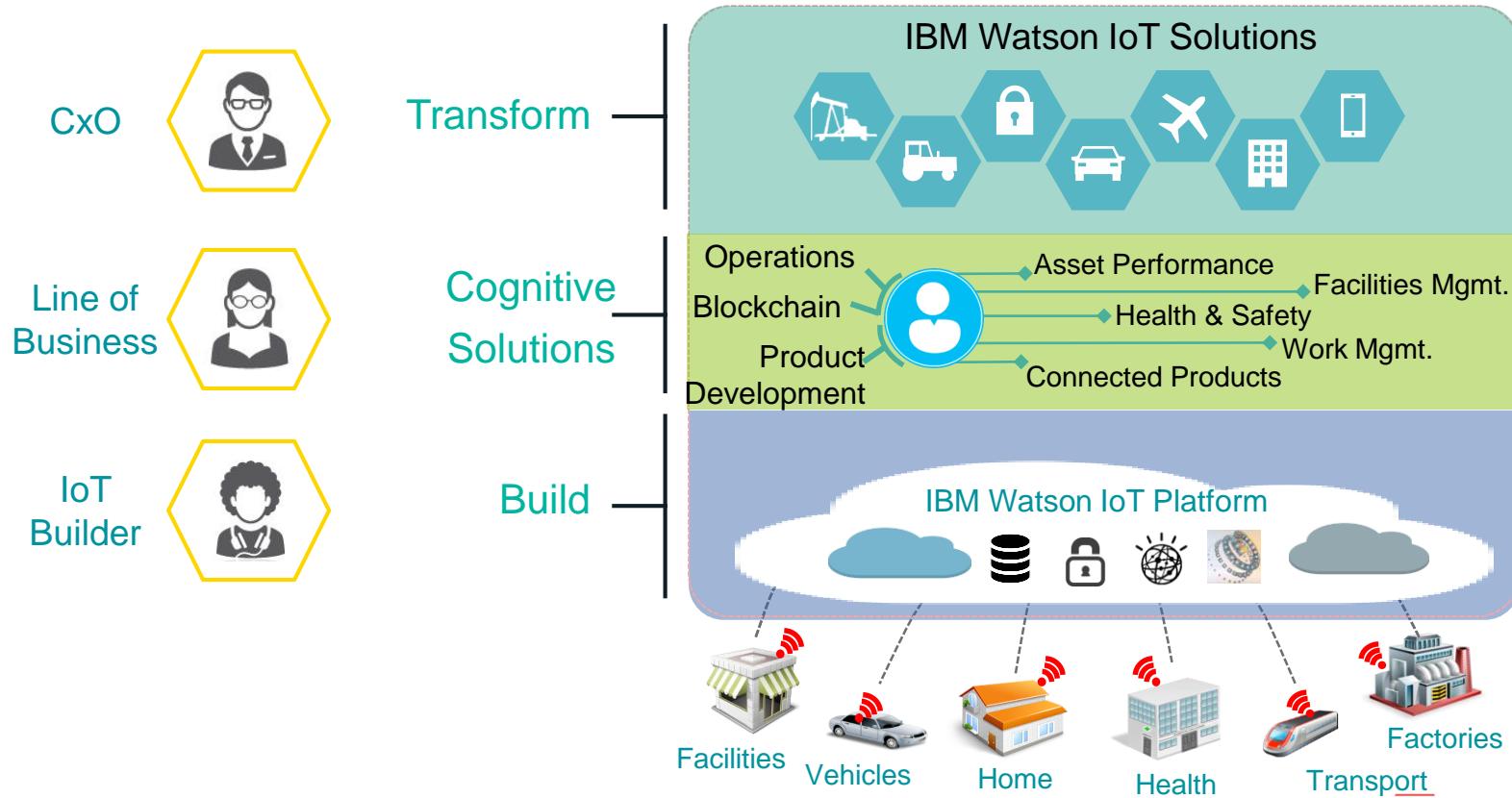
IBM Watson IoT Platform and IBM Bluemix



Overview - IBM Bluemix Section

- IBM's Viewpoint on IoT:
Digital & Business Transformation, Cognitive IoT, Ecosystem
- Software Development Life-Cycle (SDLC) to build Cognitive IoT Solution
- Bluemix and Watson IoT
 - Bluemix: Languages, Services, Boilerplates
 - Watson IoT: Platform, Recipes, Node-RED
- Lab Steps: Develop IoT App with Watson IoT (WIOT) Platform
 1. First Node-RED Flow: Bring Quickstart data into WIoT.
 2. Insert the data into Cloudant and DashDB (Optional)
 3. Device Registration
 4. Use MQTT Node to create a device simulation
 5. Explore Real-time Insights
 6. Create the HTML Dashboard

Digital / Business Transformation & IBM's Watson IoT Portfolio



Watson IoT Point of View – Cognitive IoT

Cognitive systems are a new technology that applies human-like capabilities of understanding, reasoning and learning on data, unlocking new value by quickly addressing seemingly unsolvable problems.

Cognitive IoT is a way of using machine-learning approaches to analyze and learn from data from a multitude of sources. It is the harvesting of sensor data to improve outcomes and the additional benefits from cognitive are huge

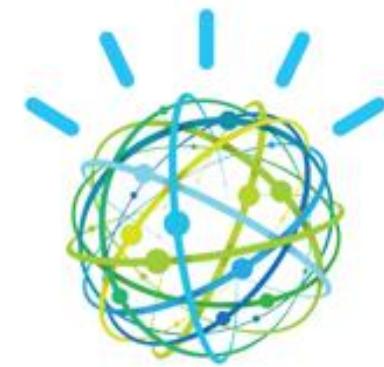
With **Watson IoT**, organizations can sense and **make sense of**

Machines
Devices
Sensors
Data

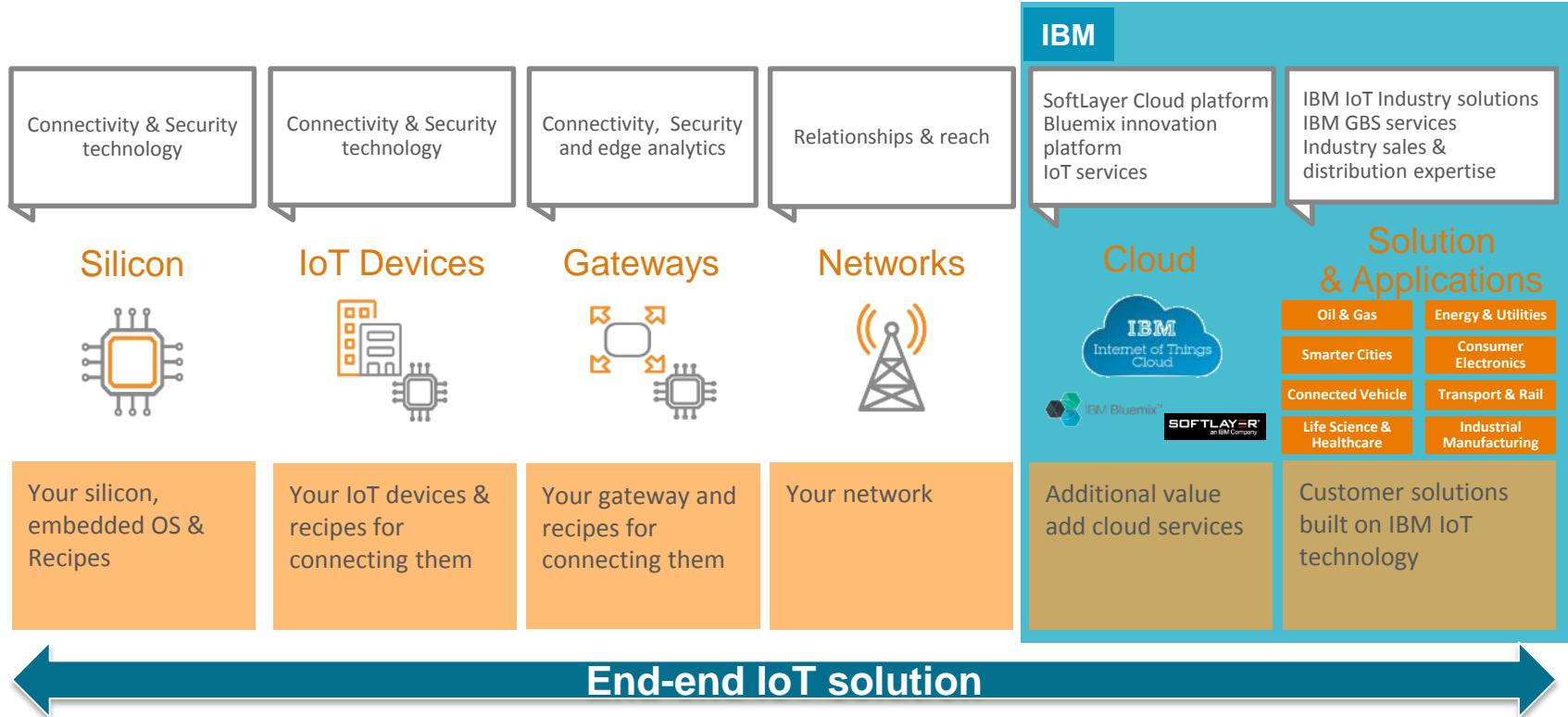
This enables them to **learn from** and **infuse** intelligence into



Business operations
Customer experiences
Products
People

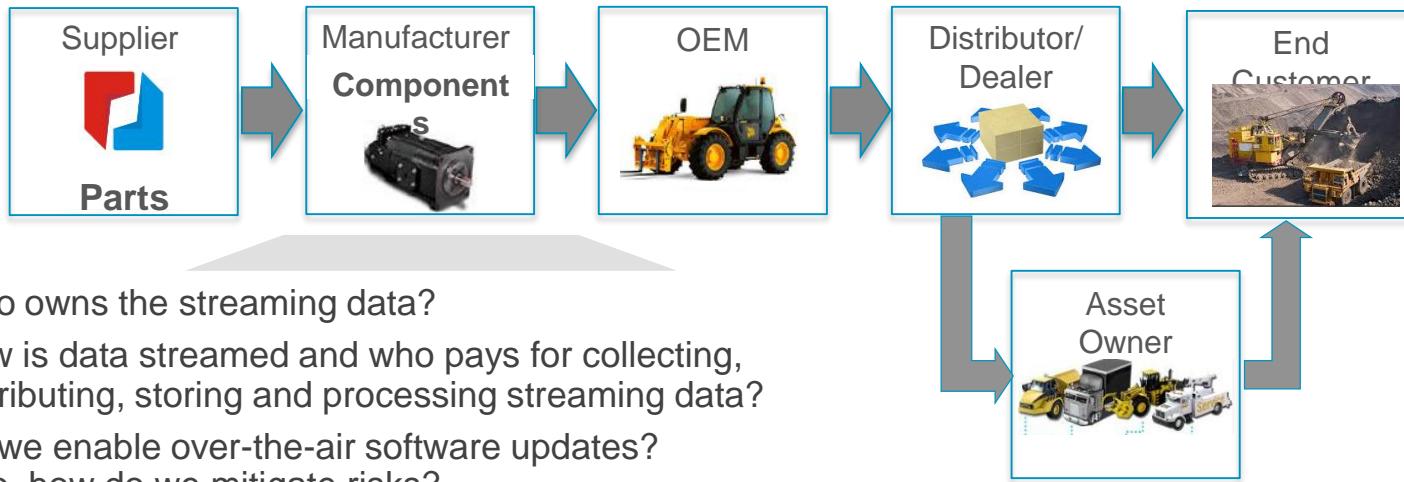


Ecosystem Horizontal Integration - Helps Companies Build and Deploy IoT End-to-End



Ecosystem Vertical Transformation

(Example: component manufacturers)



- Who owns the streaming data?
- How is data streamed and who pays for collecting, distributing, storing and processing streaming data?
- Do we enable over-the-air software updates? If so, how do we mitigate risks?
- Who builds & owns predictive models?
- Who is responsible for issuing predictions?
- How can we implement a Quality Early Warning System (QEWS)?
- What relationships can we have upstream, beyond OEM?
- Will upstream constituents be able to ingest our streams/predictions?

IBM visioning workshop applies IBM Design Thinking methodology to identify new business models

Why IBM Watson IoT ?

Industry Knowledge

Deep Industry knowledge based on 25 years Business Consulting Services

- **200,000 consultant**
- **Over 160 countries**
- **Experience with almost all business domains transformation and Innovation**

Cognitive Solutions

With over 100 years Technology innovation, IBM's IoT platform offers more capabilities, incorporating more data types, with more security than other providers.

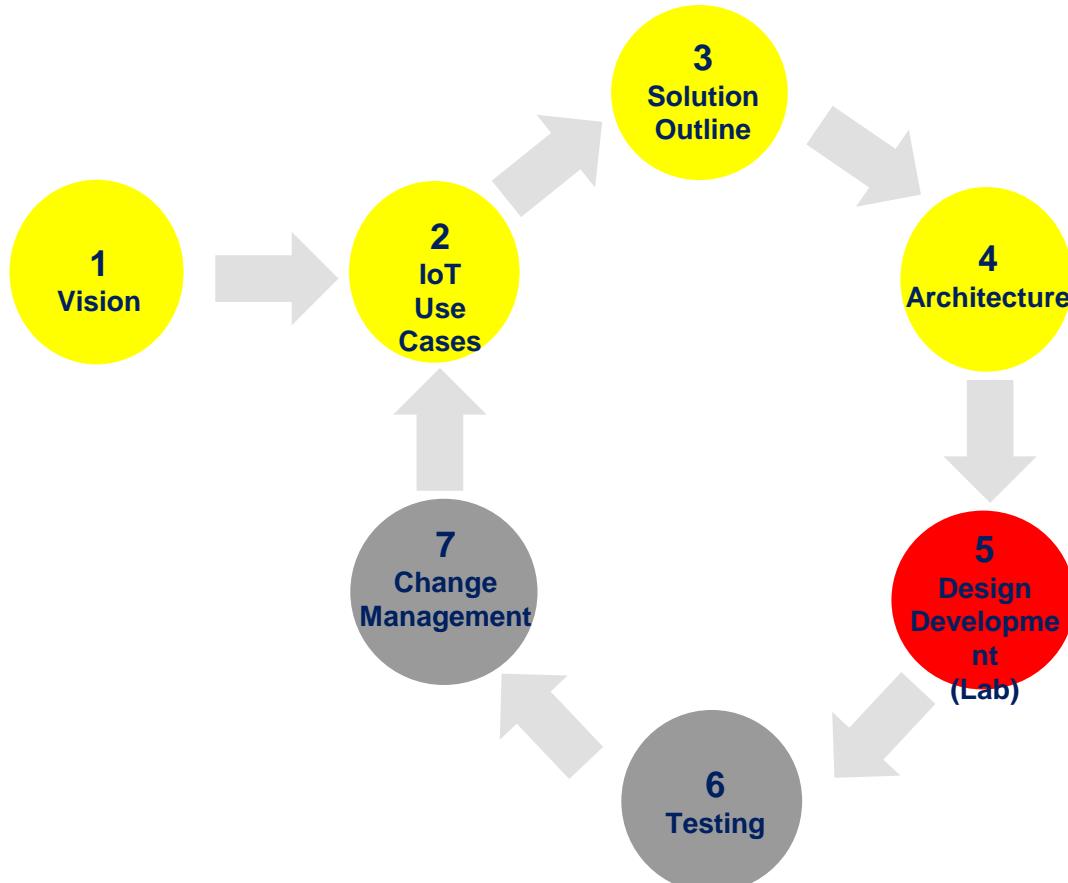
- **wide range of cognitive, predictive, and real time capabilities.** Watson, IBM's cognitive and analytic capabilities are unmatched.
- **IBM can ingest a wider variety of data types, delivering true IoT business value.** Our platform is designed to integrate data from multiple sources including client devices, IBM sources, and independent 3rd party sources.
- **IBM offers a richer security portfolio** IBM has a full suite of IoT-ready security capabilities.

Ecosystem Neutral

IBM brings a strong, neutral ecosystem and vastly deeper development experience

- **Because we are IT focused we are ecosystem neutral.** We are IT-focused and our model allows clients to build their own segregated data pools. We work with enterprises and organizations who need to keep their most critical information private and proprietary.
- **IBM has decades of experience working with developers and building developer ecosystems.** In addition to our vast experience building developer and ISV programs as a software company, IBM's substantial investments in SoftLayer and Bluemix highlight our deep commitment to Cloud and developers .

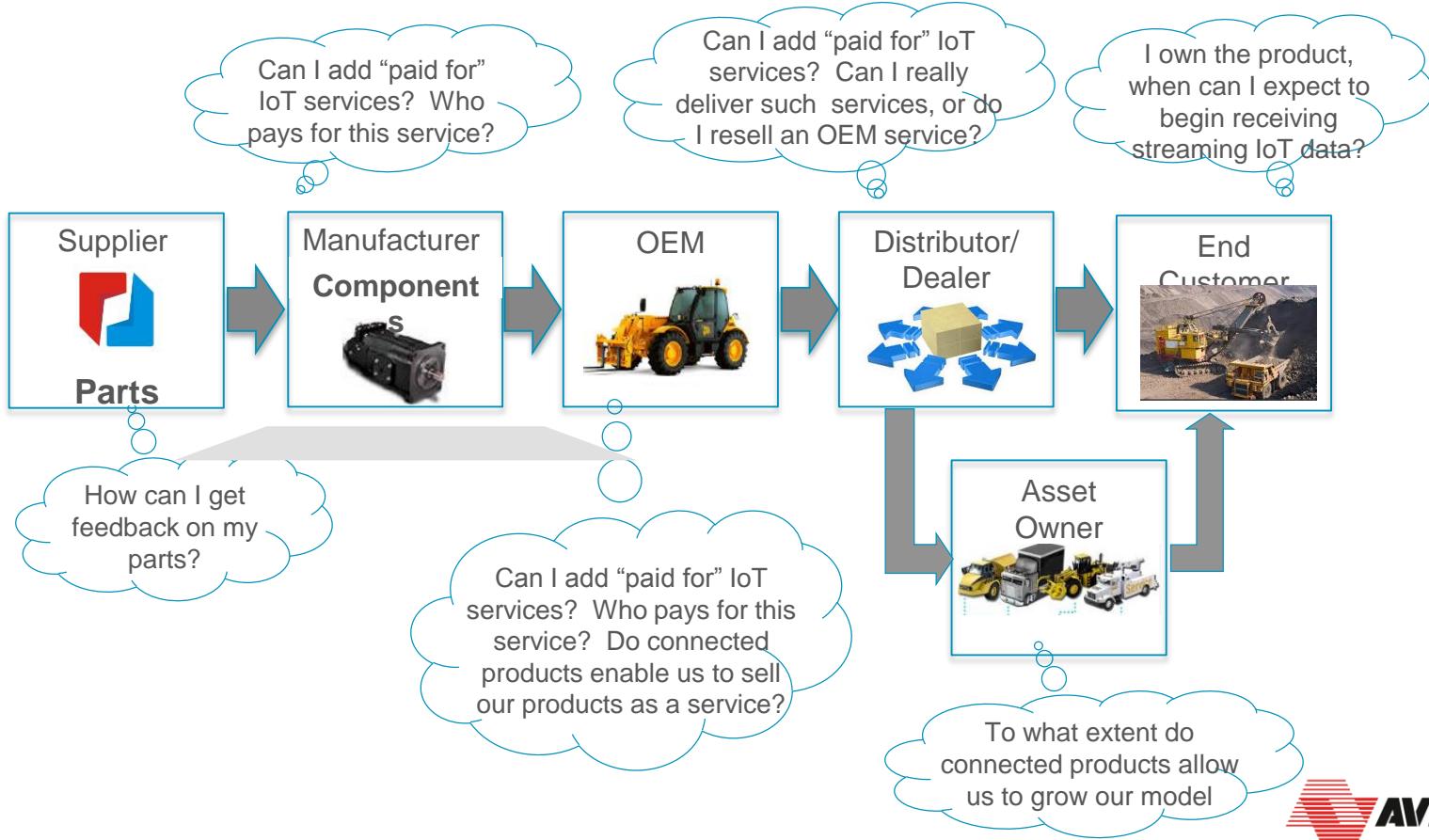
Step by Step: SDLC to build Cognitive IoT Solution



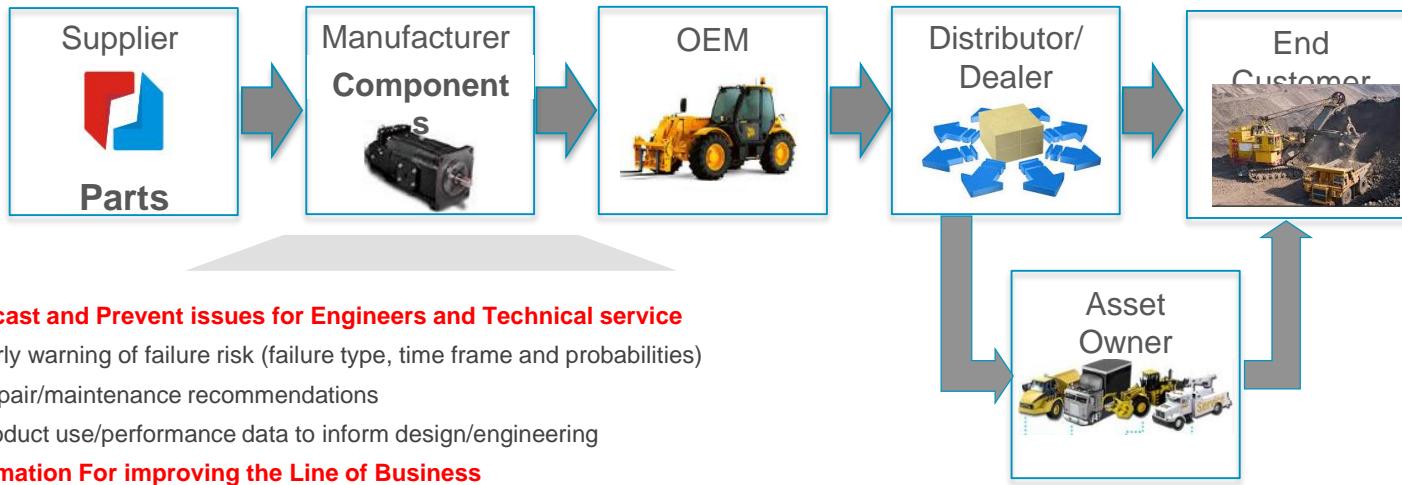
Build Cognitive IoT Solutions

- Iterative Process
- Business Transformation
- Use cases
- Solution Outline
- Architecture
- Lab Excises: Design / Development

Vision: IoT ecosystem enables business transformation



Identify, Review and Rank IoT Use cases



Forecast and Prevent issues for Engineers and Technical service

- Early warning of failure risk (failure type, time frame and probabilities)
- Repair/maintenance recommendations
- Product use/performance data to inform design/engineering

Information For improving the Line of Business

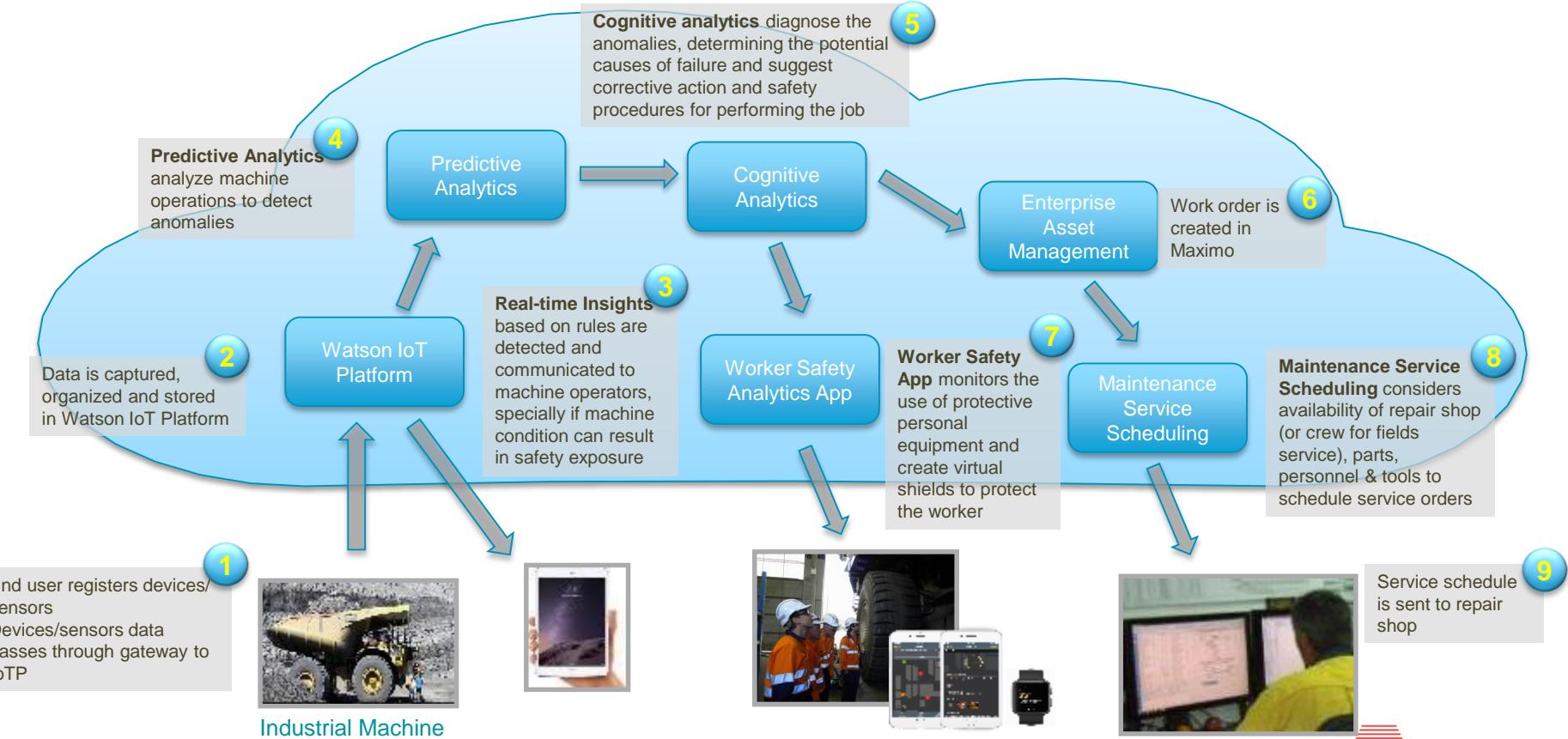
- Product use/performance data to identify supplier or manufacturing issues
- Product use/performance data to prompt software updates
- Product use/performance data to support warranty response, fraud
- Product use/performance data to detect improper installation/operation

New Business Models

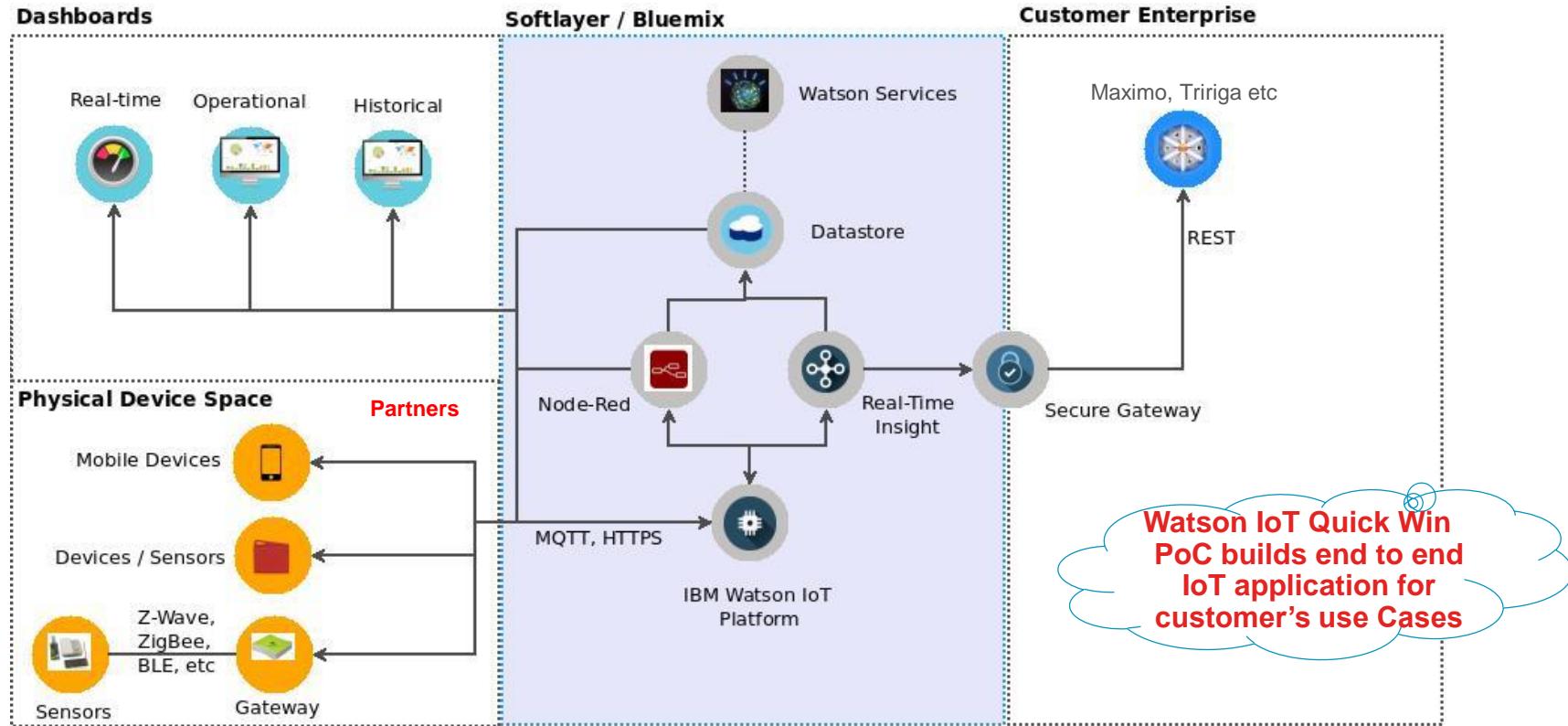
- Extended warranties
- Enable proactive maintenance campaigns
- Enable maintenance outsourcing service
- Enable offering product in a service form (gearbox function by the hour)

**IBM visioning workshop
applies IBM Design
Thinking methodology to
identify the use Cases**

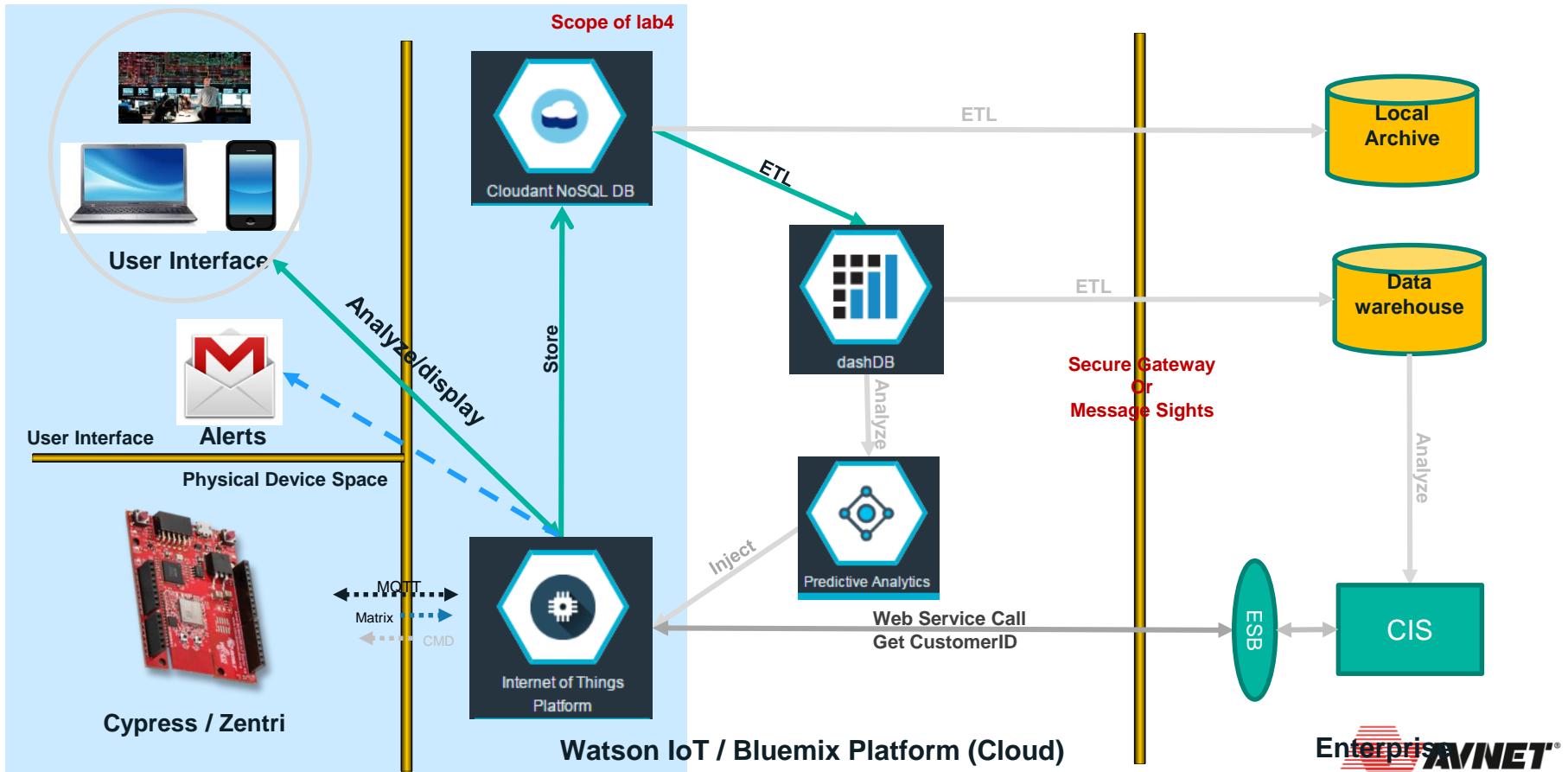
Solution Outline Example: IoT for Connected Industrial Machinery



Reference Architecture from Ecosystem to Watson IoT platform



Solution Architecture



Bluemix – Developing Applications

Choose your favorite language

Runtimes

Run an app in the language of your choice

Runtime	Provider	Status
.NET	ASP.NET Core IBM	Available
Java Liberty	Liberty for Java™ IBM	Available
.js	SDK for Node.js™ IBM	Available
.xsp	XPages IBM	Available
.go	Go Community	Available
.php	PHP Community	Available
.py	Python Community	Available
.rb	Ruby Community	Available
.swift	Swift Community <i>BETA</i>	Available (Beta)
tomcat	Tomcat Community	Available
Community buildpacks	Community	Available

<http://bluemix.net>

Bluemix – A Marketplace of Services

Compose your application from managed services

Mobile
Quickly get started with your next app

Mobile Analytics IBM BETA
Mobile Application Content Manager IBM
Mobile Client Access IBM
Mobile Foundation IBM
Mobile Quality Assurance IBM
Push Notifications IBM
Kinesis Third Party
Testdroid Cloud Third Party
Twilio Third Party

Web and Application
Deliver new web and mobile apps

Blockchain IBM BETA
Business Rules IBM
Data Cache IBM
Message Hub IBM
Session Cache IBM
WebSphere Application Server IBM
Workload Scheduler IBM
box Third Party
CloudAMQP Third Party
DreamFace Third Party
Geocoding Third Party
Hiptop Third Party
Memcached Cloud Third Party
Monalai Third Party
Payeezy Third Party
PubNub Third Party
Reappt from Push Technology Third Party
Reverse Geocoding Third Party
Searchly Third Party
SendGrid Third Party

Data and Analytics
Essential data services; limitless possibilities

HELP ME PICK

Apache Spark IBM
BigInsights for Apache Hadoop IBM
Cloudant NoSQL DB IBM
dashDB IBM
DataWorks IBM
Elasticsearch by Compose IBM
Geospatial Analytics IBM
IBM DataStage on Cloud IBM
IBM DB2 on Cloud IBM
IBM Graph IBM
IBM Master Data Management on Cloud IBM
Insights for Twitter IBM
MongoDB by Compose IBM
PostgreSQL by Compose IBM
Predictive Analytics IBM
Redis by Compose IBM
Streaming Analytics IBM
Weather Company Data IBM
ClearDB MySQL Database IBM
ElephantSQL Third Party

Integration
Extend existing investments and infrastructure

Secure Gateway IBM
Service Discovery IBM BETA
Service Proxy IBM BETA
Rocket Mainframe Data Third Party

Bluemix – Boilerplates

Get started quickly

Starters // Choose a package of sample code and services, or start from scratch

Boilerplates

Get started with a new app, now

ASP.NET Core Cloudant Starter IBM	Internet of Things Platform Starter IBM	IoT for Electronics Starter IBM	Java Cloudant Web Starter IBM	Java Workload Scheduler Web Starter IBM
LoopBack Starter IBM	MobileFirst Services Starter IBM	Node.js Cloudant DB Web Starter IBM	Personality Insights Java Web Starter IBM	Personality Insights Node.js Web Starter IBM
StrongLoop Arc IBM	Mendix Rapid Apps Community	Node-RED Starter Community	Python Flask Community	Ruby Sinatra Community

IBM Watson IoT Platform

Everything you need to Innovate with IoT

IBM Watson IoT Platform offerings

Connect

Attach, Collect & Organize, Device Management,
Secure Connectivity, Visualization

Information Management

Storage & Archive, Metadata Management, Reporting, Streaming data,
Parsing and Transformation, Manage unstructured data

Analytics

Predictive, Cognitive, Real-time, and Contextual

Risk Management

Security Analytics, Data Protection, Auditing/Logging,
Firmware Updates, Key/Cert Mgmt, Org Specific Security

IoT Industry Solutions

Third Party Apps

IBM Watson IoT Platform



Analytics



Risk Management

Connect

Attach: MQTT, HTTPS
Collect & Organize
Device Management
Secure Connectivity
Visualization

Information Management

Storage & Archive
Metadata Management
Reporting
Parsing and Transformation
Manage unstructured data



Flexible Deployment



IBM Watson IoT

AVINET®

DeveloperWorks Recipes

Get started quickly

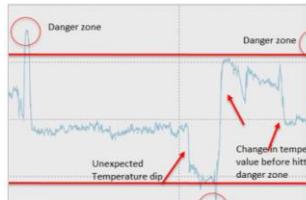


Introducing ZentriOS Application Support for IBM Watson IoT Platform

Created on Jul 28, 2016

Uses ZentriOS to exchange sensor data with Bluemix cloud solution in a few simple steps

Ayman Grais 706 0 0



Engage Machine Learning for detecting anomalous behaviors of things

Created on Apr 10, 2016

This recipe showcases how we can make use of the Predictive Analysis service, available on the IBM ...

Recipes@IoTF 5K+ 7 5

- Show developers, makers how to connect devices
- How to samples and tutorials for integration with Bluemix services
- Industry specific use-cases
- Rapidly growing ecosystem of recipes provided by SMEs
- Open community driven site – publish your own recipe

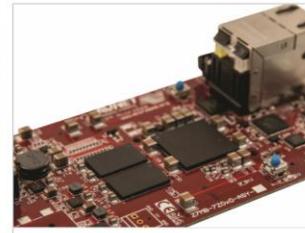


AV01 – Connect to IBM Watson IoT using Avnet BCM4343W IoT Starter Kit

Created on Mar 21, 2016

("Quickstart" using Cypress WICED SDK and IBM Watson IoT)

Peter949 1012 0 0



Connecting to IBM Watson using Avnet's MicroZed

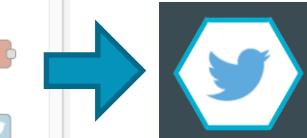
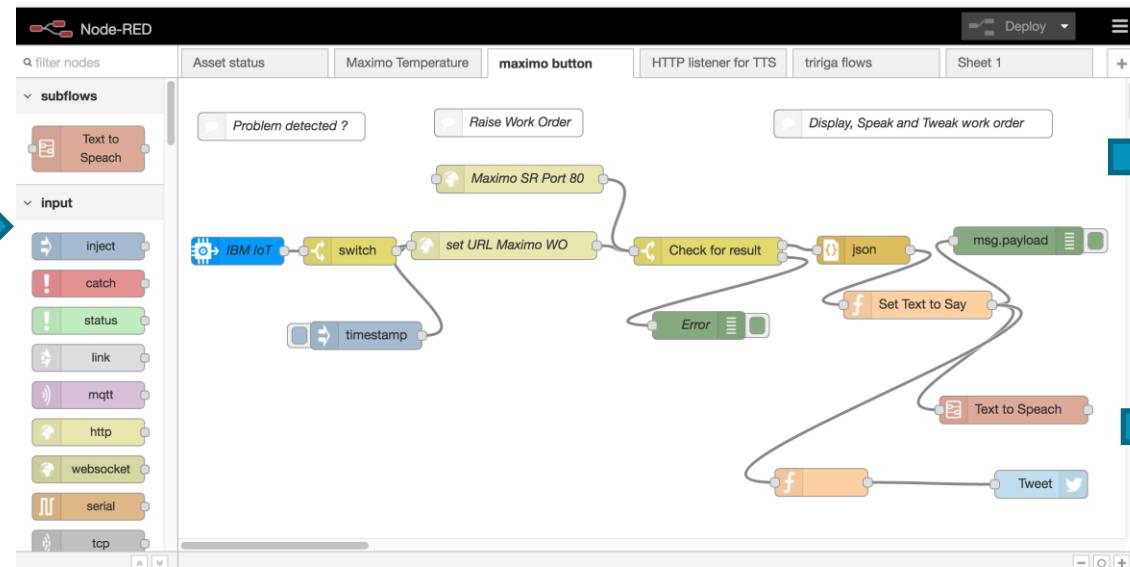
Created on Feb 11, 2016

In this recipe, you will take the Wind River Pulsar platform on Avnet's MicroZed and add Paho MQTT ...

AvnetEM 876 3 0

Node-RED – A Visual Tool For Wiring the Internet of Things

Physical meets Digital example

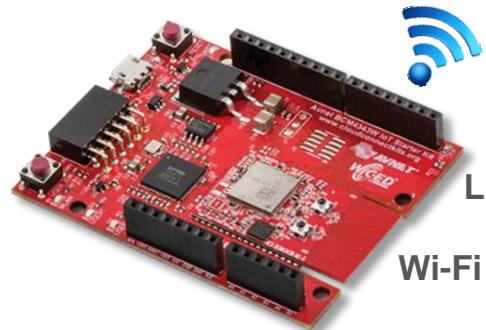


Integrated with github for change management
<https://github.com/>

Workshop Lab 4

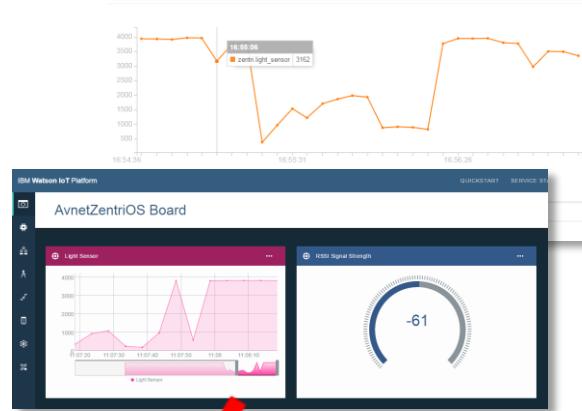


Lab 4 - System Diagram



Light Sensor

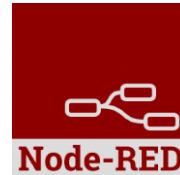
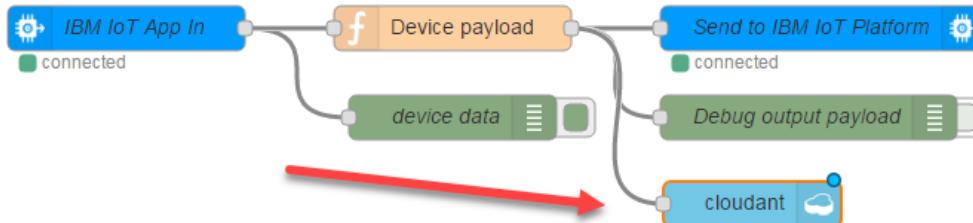
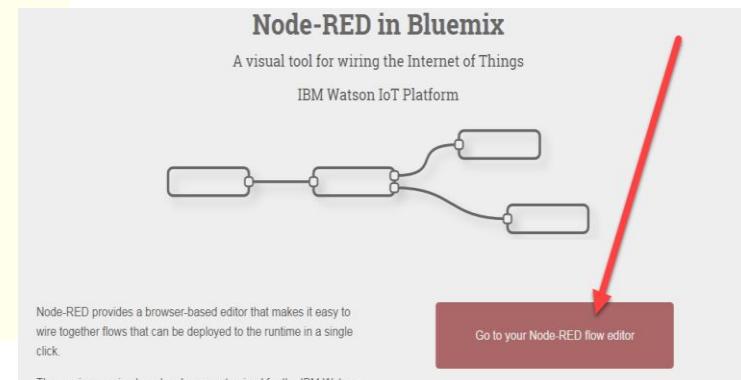
Wi-Fi RSSI



Lab 4 - Use Node-RED to integrate other Bluemix services

Beyond IBM Watson IoT Platform MQTT broker and QuickStart charting, this lab explores the use of other IBM Bluemix services:

- Flow editing + debug using Node-RED
- Creating a custom dashboard
- Setting-up email notifications
- Data storage using Cloudant DB
- Data storage using DashDB



Lab 4 - Objectives

- 1) Build, Run and Download Zentri example Bluemix App
- 2) Test it! - Using IBM QuickStart Charting



- 3) Wire to additional Bluemix services using Node-RED
- 4) Test it! - Using Node-Red Debug Monitor



Lab 4 - Objectives (continued)

- 5) Register your device in Bluemix Services
- 6) Create Custom Dashboard and Visualization Cards
- 7) Test it! - Using custom Dashboard Display (RTI)



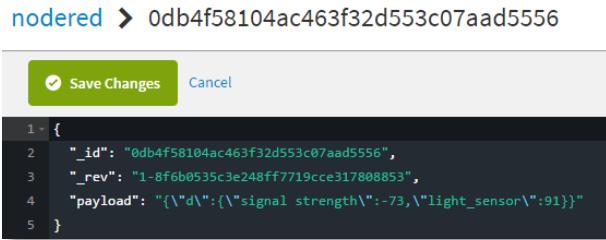
- 8) Create a Device Schema for Email Alerts
- 9) Create an Email Alert Rule
- 10) Test it! - Using Email Notification Alerts



Lab 4 - Objectives (continued)

11) Setup & test data storage using Cloudant DB

nodered ➤ 0db4f58104ac463f32d553c07aad5556



```
1  {
2    "_id": "0db4f58104ac463f32d553c07aad5556",
3    "_rev": "1-8f6b0535c3e248ff7719cce317808853",
4    "payload": "{\"d\":{\"signal_strength\":-73,\"light_sensor\":91}}"
5 }
```

Save Changes Cancel

12) Setup & test storage of data using using DashDB

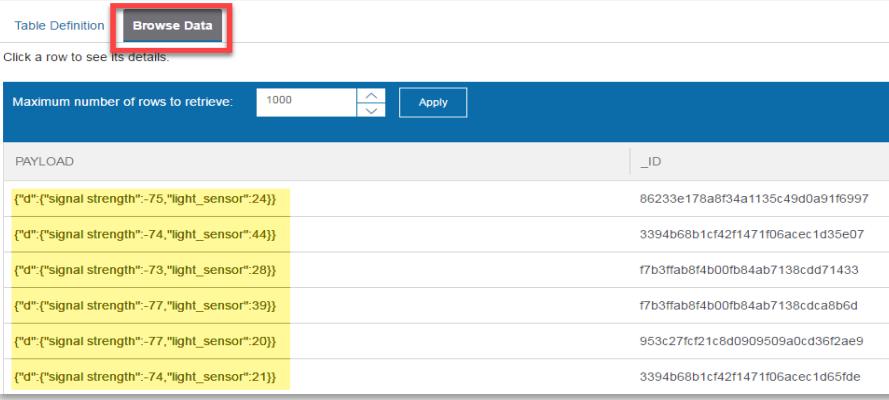


Table Definition **Browse Data**

Click a row to see its details.

Maximum number of rows to retrieve: 1000 Apply

PAYLOAD	_ID
{"d":{"signal_strength":-75,"light_sensor":24}}	86233e178a8f34a1135c49d0a91f6997
{"d":{"signal_strength":-74,"light_sensor":44}}	3394b68b1cf42f1471f06acec1d35e07
{"d":{"signal_strength":-73,"light_sensor":28}}	f7b3ffab8f4b00fb84ab7138cd71433
{"d":{"signal_strength":-77,"light_sensor":39}}	f7b3ffab8f4b00fb84ab7138cdca8b6d
{"d":{"signal_strength":-77,"light_sensor":20}}	953c27fcf21c8d0909509a0cd36f2ae9
{"d":{"signal_strength":-74,"light_sensor":21}}	3394b68b1cf42f1471f06acec1d65fde

Lab4 – IBM Bluemix Accounts

- **Sandbox Temporary Accounts**

To avoid delay, temporary accounts are provided for this workshop

Credentials for these accounts are in the following format:

Email Login	Password	Space	Organization	First Name	Last Name	Security Answer
bm1@avnet.com	temp1avnet	TEMPBM1	Temp Bluemix Accounts	Temp	1	Avnet
bm2@avnet.com	temp2avnet	TEMPBM2	Temp Bluemix Accounts	Temp	2	Avnet
bm3@avnet.com	temp3avnet	TEMPBM3	Temp Bluemix Accounts	Temp	3	Avnet

- **Lab4 Appendix B** Provides detail on how to create your own IBM Account...

This can be done from the sidebar of the Quickstart page, eg

https://quickstart.internetofthings.ibmcloud.com/#/device/zentri_4432/sensor/

or from the main Bluemix landing page:

<https://new-console.ng.bluemix.net/>

Support Resources and Training



Avnet CloudConnectKits.org Website

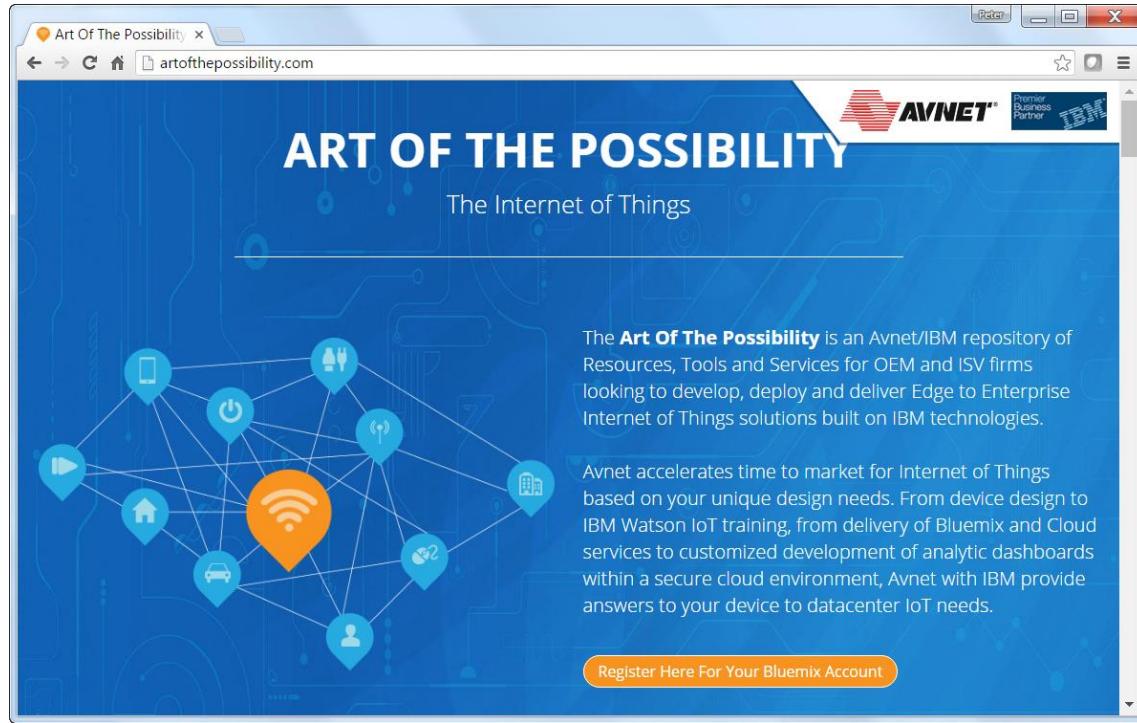
The screenshot shows the homepage of the Avnet CloudConnectKits.org website. At the top, there's a navigation bar with links for Home, Products, Buy, Forum, Sponsors, Sign in/Register, and a search icon. Below the navigation is a large banner featuring the Avnet logo and the text "Introducing the Avnet BCM4343W IoT Starter Kit". A red IoT starter kit board is shown prominently. Below the banner, a sub-section titled "Introducing the Avnet IoT" features a photo of hands holding the kit. Other sections include "Powered by Broadcom's WICED and Amazon Web Services" and "About CloudConnectKits.org".

The screenshot displays three pages from the website:

- Products Page:** Shows the "Avnet BCM4343W IoT Starter Kit" and the "Avnet BCM4343W SoC Module". Each product has a "VIEW PRODUCT" button.
- Discussion Forums Page:** Features a header "Discussion Forums" and a table of forums. The forums listed are:

Forum	Topics	Posts
AT&T Cellular IoT Starter Kit	1	1
BCM4343W Starter Board Hardware	12	31
LSR Wireless Shield	0	0
BCM4343W Starter Board Software	47	202
BCM4343W Module	15	41

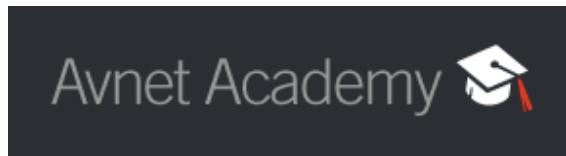
Art Of The Possibility Website



[ArtOfThePossibility.com](#)

- Resources
- Tools
- Services
- Training...

Additional Avnet Online Training Resources



FREE Self-Paced Bluemix and Watson IoT
On Demand Trainings! (\$500 value)

[Building Highly Scalable Apps on the Cloud with Bluemix \(BMA01G\)](#)

This Bluemix workshop that introduces basic concepts for creating, deploying, and managing applications on IBM Bluemix Cloud Foundry based platform.

[Avnet MicroZed Board with IBM Watson IoT Platform \(BMA03G\)](#)

This intermediate level course expand and extend the knowledge you've developed with our Building Highly Scalable Apps on the Cloud with Bluemix into Internet of Things technologies

Promo code: **IOTGetStarted**

Where to go for Support?



Avnet CloudConnectKits User Forum

<http://cloudconnectkits.org/forum>



Avnet Documentation

<http://cloudconnectkits.org/product/avnet-bcm4343w-iot-starter-kit>



Cypress WICED Wi-Fi Forum

<https://community.cypress.com/community/wiced-Wi-Fi>



ZentriOS SDK Support pages

<https://docs.zentri.com> and <http://support.zentri.com>



IBM Bluemix QuickStart Recipes and Resources...

<https://developer.ibm.com/recipes> and
<http://ArtOfThePossibility.com>



BCM4343W IoT Starter Kit Online Training

<https://www.youtube.com/embed/AjVZJcxaEQk>

<https://www.youtube.com/embed/FkNtxAsljgl>

<http://cloudconnectkits.org/>

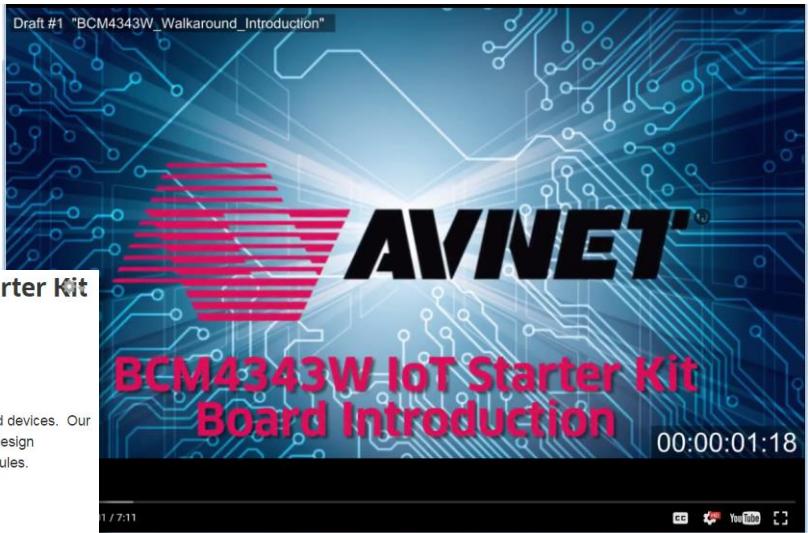


Introducing the Avnet BCM4343W IoT Starter Kit

Watch the video for a full kit overview.

About CloudConnectKits.org

Welcome to the site specifically targeting designers of cloud enabled, connected devices. Our goal is to provide you with the information, resources and support you need to design connected solutions based on our Cloud Connect Starter Kits and wireless modules.



Avnet IoT Starter Kit at Embedded World

David Armour (IoT Technologist with Broadcom) in EBV's booth at the 2016 Embedded World event, discussing the new AVNET BCM4343W IoT Starter Kit and Broadcom's WICED SDK development tools.



> and more to come...

