



MICROCHIP

Microchip IoT Solutions

Considerations for Embedded Internet of Things Designs

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IoT - The Internet of Things

- **Total installed base of Connected Devices**
 - Computers, Tablets, Smartphones, Embedded Devices etc.
 - Expected to be >200billion by 2020*
- **Of this**
 - ~30billion are connected things*
- **But what is a thing....**
 - Autonomous sensors, actuators, systems, devices
 - M2M Communications
 - Collecting data
 - Responding to conditions
- **In short, an embedded system...**
 - ...with significant consideration for the effects and implications of connectivity and security

IoT - The Internet of Things

- **From an embedded engineers perspective**
 - It takes what we have provided for many years as stand alone systems, and adds connectivity, security and infrastructure
 - Connectivity is migrating to wireless
 - Infrastructure is moving to Cloud based systems
 - leveraging smart devices and internet infrastructure
 - HMI is moving to smart devices
 - This changes how users interact with systems
 - Affects business models for installation, support, servicing etc.

What does the IoT do for us?

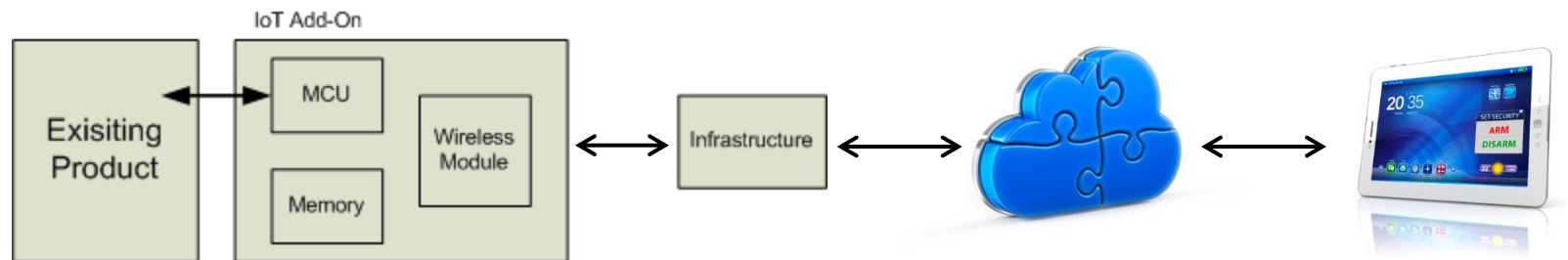
- **Commission using Smart Devices**
- **Remote Access and Control**
- **Profile and Status monitoring**
- **Remote Diagnosis**
- **Field Updates**
- **Data Collection**
- **Alerts, Warnings and Updates**

Getting IoT Ready

Bolt-On OR New Design

- **Add IoT capability to known good product**

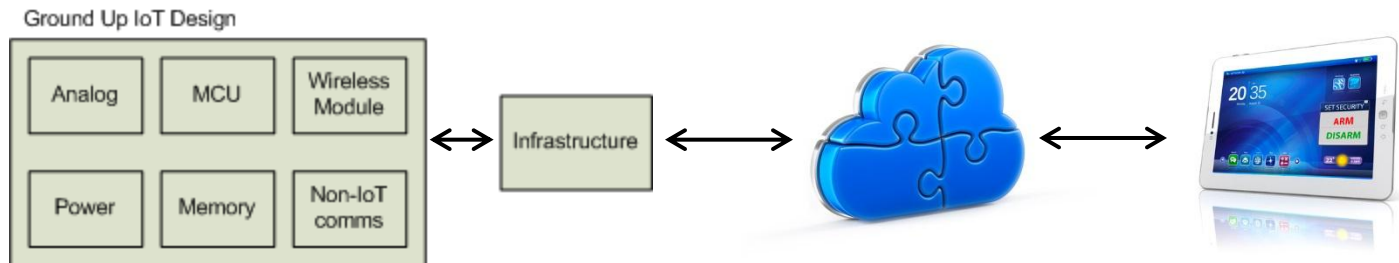
- Product has existing comms interface, protocol and command set
- No new commands or functions needed
- Simple upgrade to make device IoT capable
- May not benefit from all features e.g. Updates
- Intention is
 - Minimal changes to current design
 - Short design cycle



Getting IoT Ready

Bolt-On OR New Design

- **Ground Up Design of Product to IoT enable**
 - Benefit from recent technology
 - Full ground up functionality for IoT
 - Longer design cycle –v- improved cost
 - Design in security and robustness features
 - Class B system integrity checks
- Robust bootloaders
 - Multiple Images stored in serial flash
 - Dual Panel, Live Update capability on MCU
- Comms designs become software biased
 - Hardware design is crucial but largely a ‘normal’ embedded design
 - Needs greater memory resource to handle increased software complexity
 - IoT functionality leverages security and comms in software





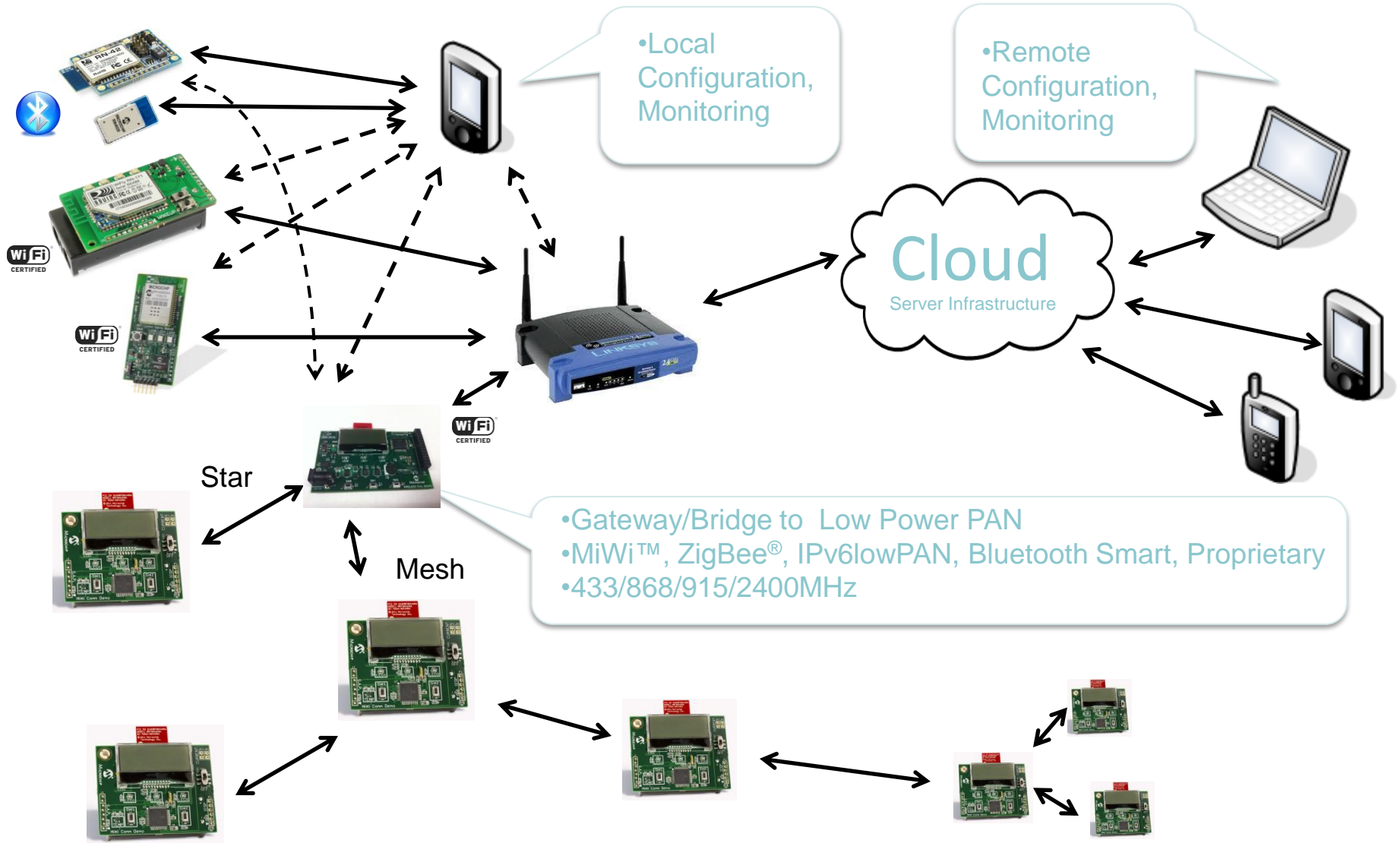
- **Security is a Primary Design Consideration**

- You are connecting a device to the internet...
- Assume you are a target is a good starting point
- Use standards based cryptography
 - AES-128 or better, SSL/TLS
 - Strong Key management
- Leverage infrastructure security
 - WPA2, Secure Simple Pairing etc.
- Write robust application code
 - Test for common issues, Unit testing etc.
 - Buffer Overflows, Bounds checking values, error handling



- **Robustness is a Primary Design Consideration**
 - You're device is remote and engineer visits are expensive
 - Need ability to autonomously recover from faults
 - Creating a brick should be avoided
 - Reliable, Secure bootloader employed
 - Consider local bulk storage for bootload images
 - Add >2x Maximum MCU flash size as NV Storage
 - Provides space for multiple images of MCU flash
 - Can keep Last Known Good, Next New, Recovery etc. images
 - Consider 'Recovery Image'
 - Minimum functionality to connect to a secure recovery server in case of corruption or disaster recovery
 - Separate Bootload from Secure Download
 - Images held locally
 - Can be integrity checked with server
 - Could be stored locally in encrypted format (additional memory!!)
- Test, Test and Test again...
 - 'Normal' embedded design testing needs to be supplemented with Comms and Security testing

Embedded Wireless System Options



So what is the Cloud?



- What Does it do for me?
- How does it affect me?

So what is the Cloud?



- **In simplistic terms it is client server computing**
 - Historically the server would be owned by and reside within the owners property
 - Cloud computing moves the server side services to an off-site location and moves to greater reliance on comms. infrastructure
 - Generally servers are real or virtual and within a large non-descript location
 - Lots of physical security measures
 - Usually use latest fault tolerant and redundancy technology
- **But how does that benefit me and my company?**
 - Low cost of ownership
 - No capital outlay and cost write down on the books
 - Scalable
 - Need more resources, simply add more
 - No need to plan ahead for capital requisition, raise PO, wait for product to arrive, install maintain and pay off capital
 - Redundancy
 - Data and services can be replicated in multiple locations

So what is the Cloud?



- **And how does it affect me?**
 - Moves a historically embedded, hardware oriented design into the murky worlds of IT, Comms, App and Web development
 - Security becomes a primary embedded design consideration
 - Need to interface with IT and Software professionals
 - Marketing input and decisions on usability, Look and Feel, branding etc.

Business Concerns

Wireless Costs

To add wireless:

- **RF Design expertise**
 - Not Digital, Not Analog, It's RF!
- **Expensive RF Lab equipment**
 - Spectrum Analyzers, Signal Generators, Faraday Cage
- **Increased Manufacturing Complexity**
 - RF Calibration and Test Equipment
- **Agency Regulations**
 - FCC, ETSI, IC, KCC, Telec
- **Standards Body Compliance**
 - BT SiG, Wi-Fi.org, Zigbee.org
- **Time to Market**
 - Additional expertise, equipment and regulatory factors MAY increase time to market



Microchip's GOAL: Make it Easy!

Microchip IoT Solution Building Blocks

Embedded Products

- Microcontrollers
- Memory
- Analog



Firmware and Software Stacks

- TCP/IP
- Bluetooth
- Wi-Fi
- MiWi™ (Lightweight Communications)
- WiFly (Serial Interface)
- SSL/TLS Security
- AES 128/256



Wireless and Ethernet

- Wi-Fi® Modules
- Bluetooth® Modules
- Ethernet Solutions
- CDMA/GSM



Cloud Solutions/Partners

- Microchip Cloud Image
- Third Party Cloud Providers



MPLAB® Harmony Architecture



Application Layer

- Implements the overall desired behavior
- No direct HW access enables easy porting across Microchip parts

Common System Services

- Manages shared resource modules to avoid conflicts.
- Provides common functionality to avoid duplication

Middleware

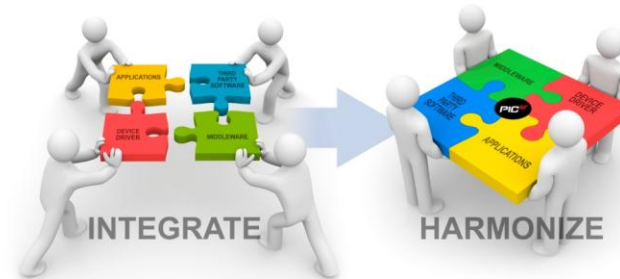
- Implements complex libraries & protocols (USB, TCP/IP, Graphics etc)
- Provides highly abstracted application program interface

Device Drivers

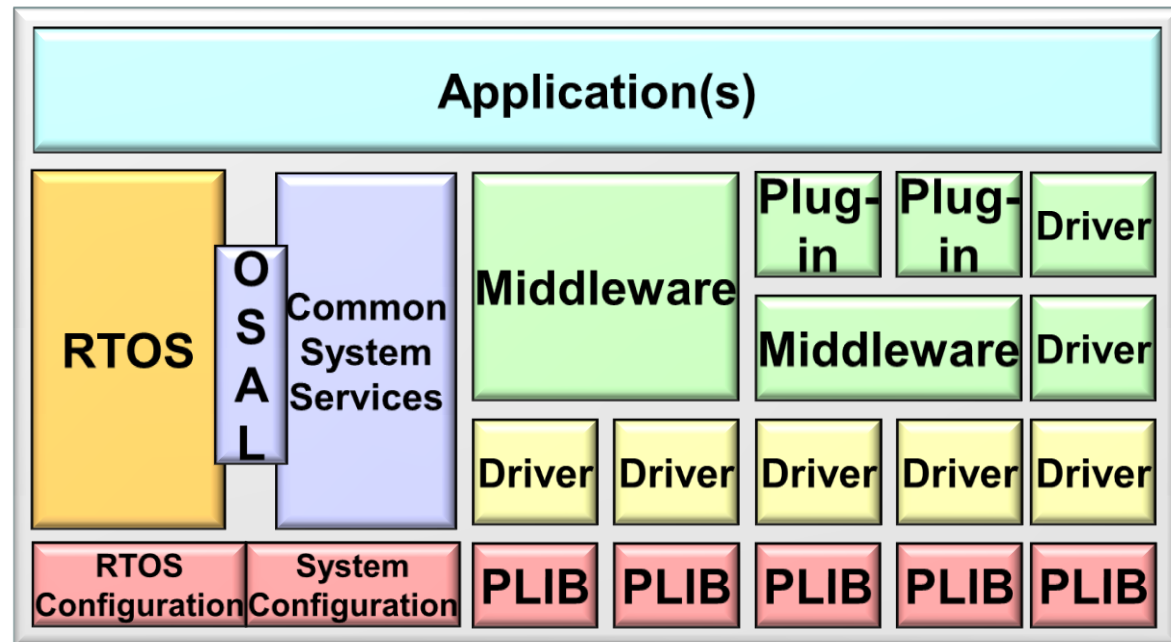
- Provides simple & abstracted interface to peripheral
- Manages peripheral access control to avoid conflicts

Peripheral Libraries (PLIB)

- Access library that provides low level direct access to a peripheral
- Provides common functional interface for MCHP cross micro compatibility



MPLAB® Harmony



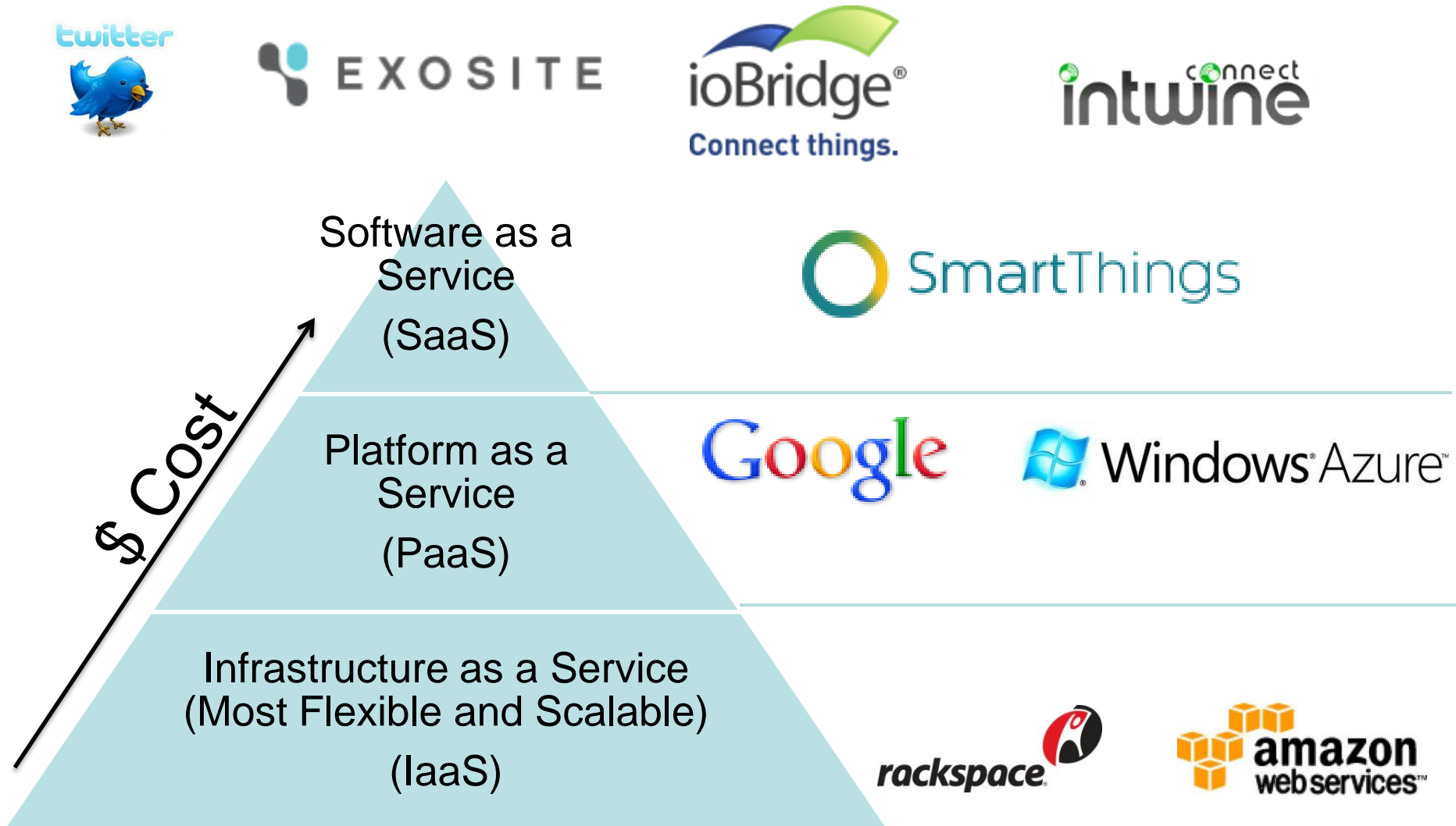
- **WolfSSL**

- Provide SSL/TLS solutions targeted at small memory footprint embedded systems

- **CyaSSL**

- Is the 3rd party SSL library developed by wolfSSL
- Integrates easily into MPLAB Harmony
- Features
 - Supports upto TLS 1.2, DTLS 1.2
 - Supports variety of Ciphers and PKI capabilities
 - Small footprint – 20 -100kB Flash, 1-36kB RAM
 - 20x smaller than OpenSSL
 - Clear Licence - GPLv2/Commercial

The Cloud “Stack”



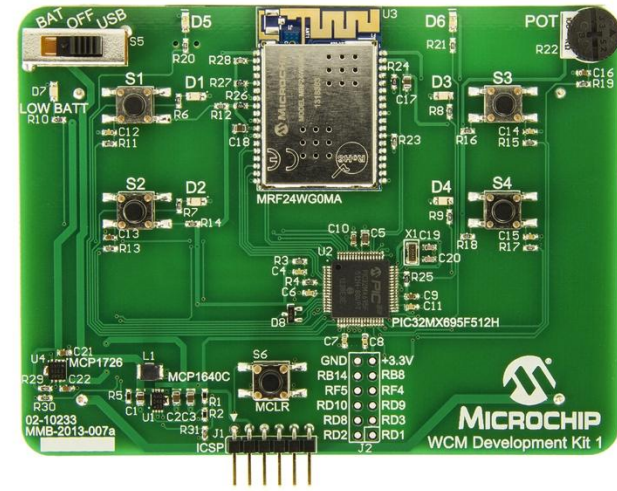
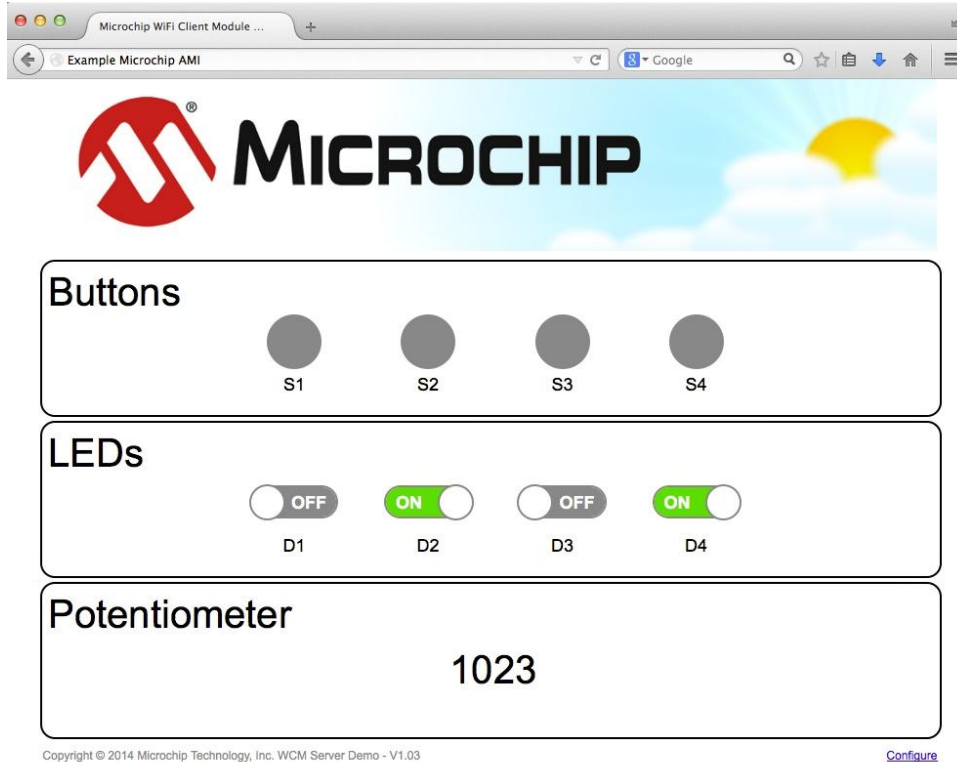
You Want the Best of Both Worlds

- **Ease of development of SaaS without the cost or Lock-In**
- **Availability and Scalability of IaaS plus the get-off-the-ground ease of SaaS**
- **Low cost of entry**
- **Ease of quick prototype**

Microchip and Amazon AWS

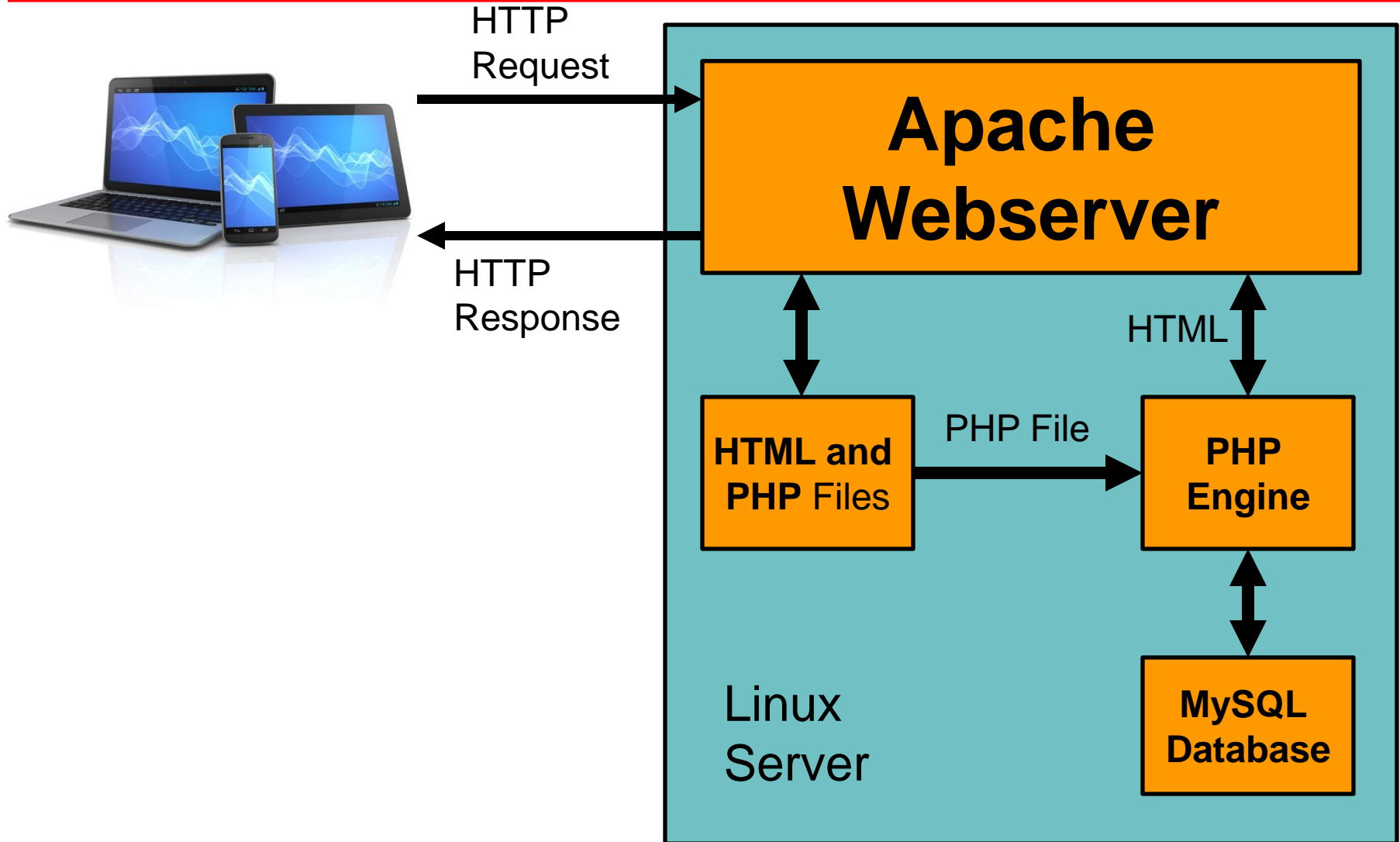
- **Amazon provide**
 - Massive, cost effective, scalable infrastructure and services
- **Microchip has created a server image that is available at Amazon for free**
 - Linux, Apache, PHP, MySQL
 - Preconfigured to work as a web-based compliment to the WCM Demo Kit
- **Microchip works directly with Amazon's AWS staff to provide solutions that can be deployed with Microchip embedded hardware and Amazon servers**
 - Solution = Client hardware + Pre-configured Server image as a hybrid SaaS + PaaS + IaaS.
 - Low cost of entry
 - Quick to prototype with complete software/firmware transparency

WCM Development Kit 1

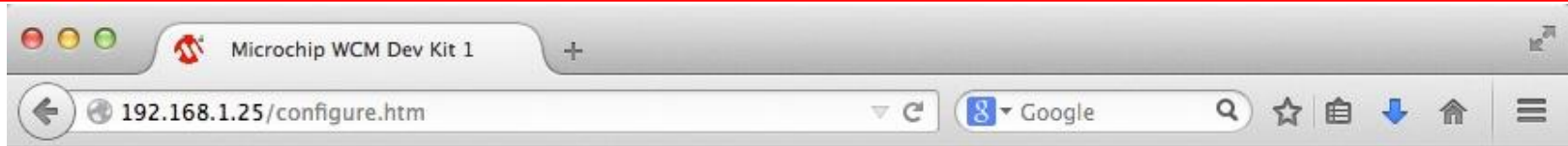


**WCM Development Kit 1
(DM182020)**

How it works as a platform



Enter AP / EC2 Info

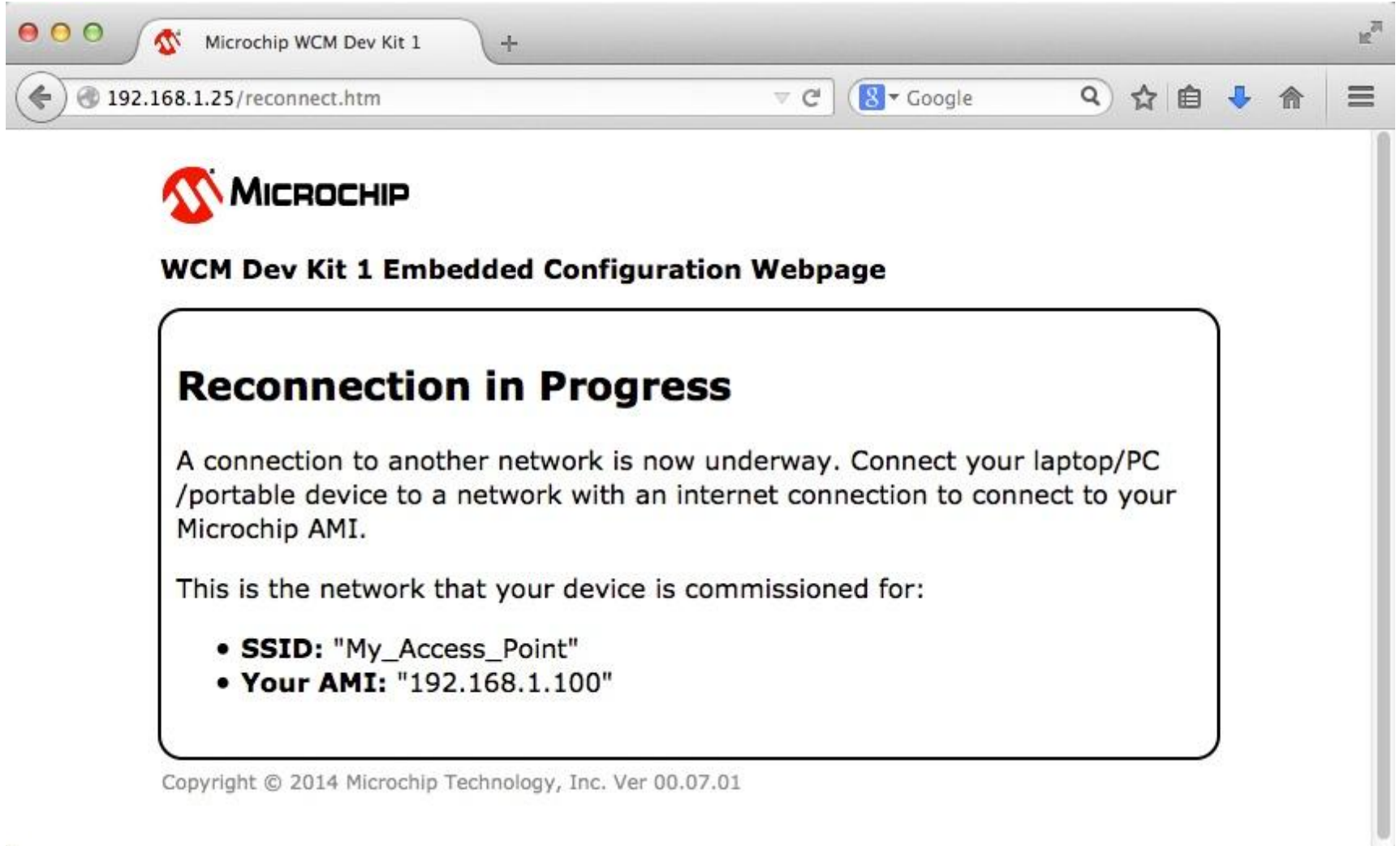


WCM Dev Kit 1 Embedded Configuration Webpage

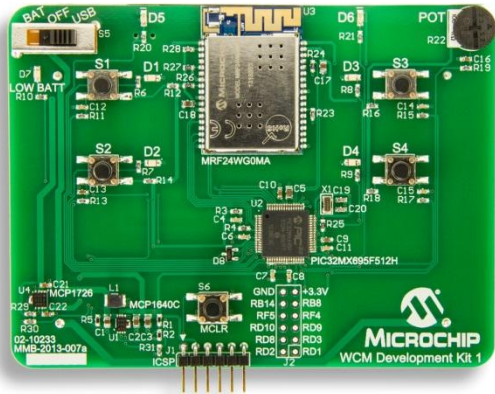
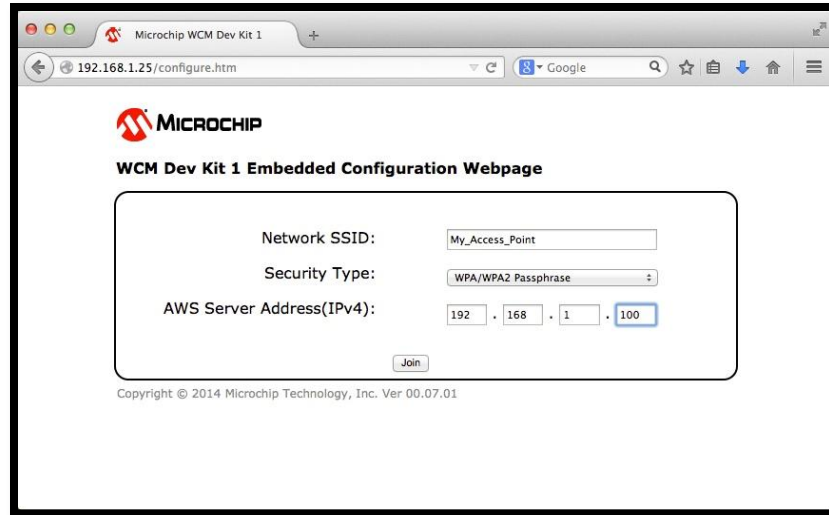
Network SSID:	<input type="text" value="My_Access_Point"/>
Security Type:	<input type="text" value="WPA/WPA2 Passphrase"/>
AWS Server Address(IPv4):	<input type="text" value="192"/> . <input type="text" value="168"/> . <input type="text" value="1"/> . <input type="text" value="100"/>
<input type="button" value="Join"/>	

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Reconnection



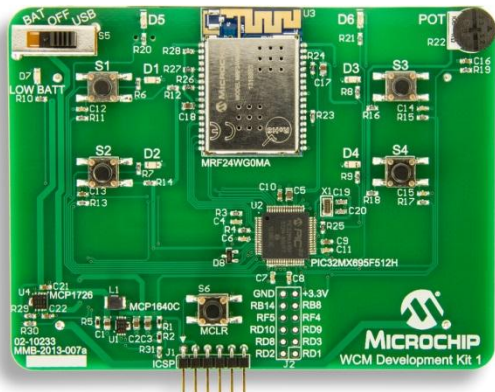
How We Commission WCM Development Kit 1



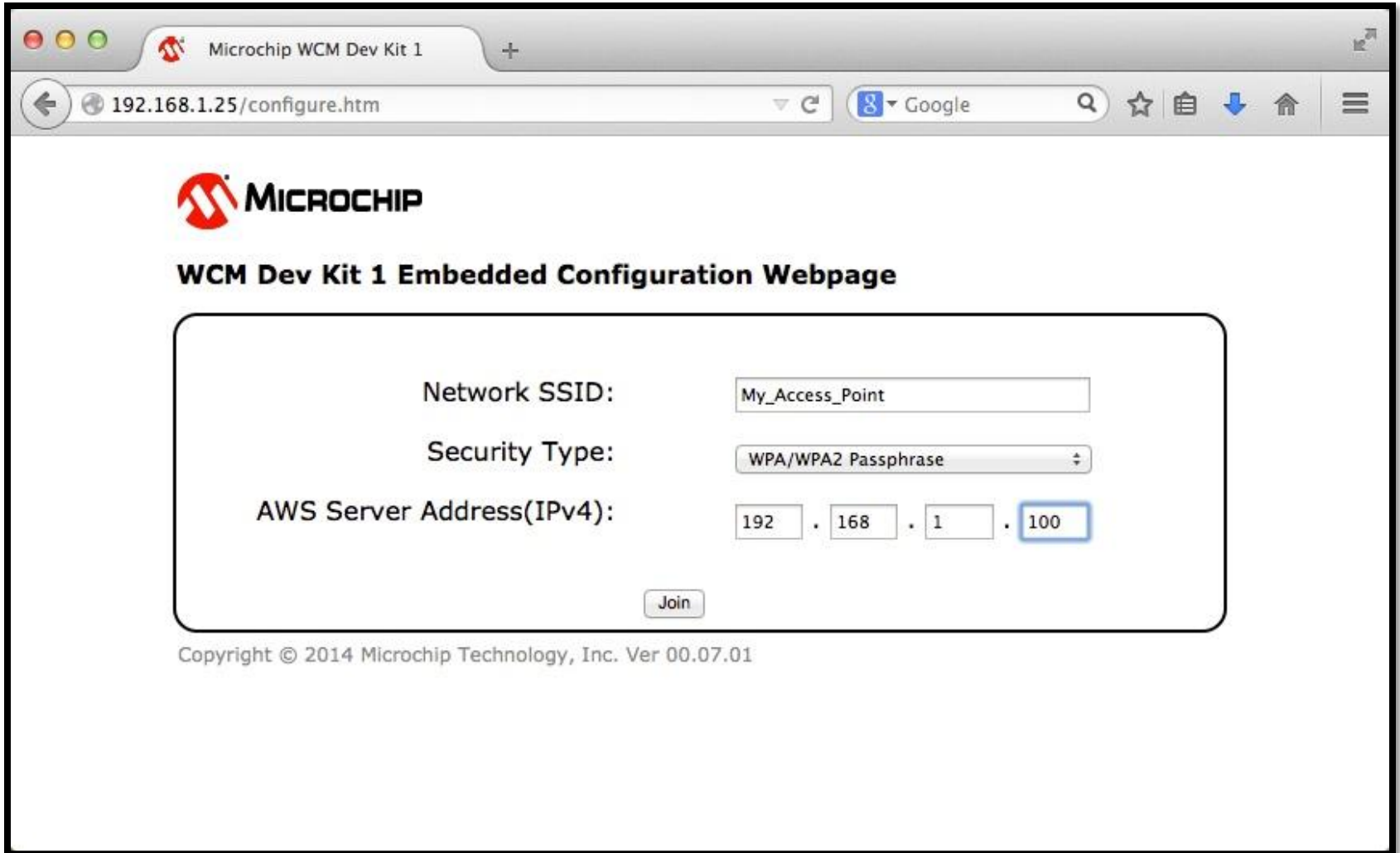
Soft AP Mode

- Allows device to become centralized coordinator for network (like an Access Point)

SSID: WCM_Soft_AP_XXXX



Configuration Webpage



The screenshot shows a web browser window with the title "Microchip WCM Dev Kit 1". The address bar displays "192.168.1.25/configure.htm". The page content includes the Microchip logo and the title "WCM Dev Kit 1 Embedded Configuration Webpage". A configuration form is enclosed in a rounded rectangle, containing three fields: "Network SSID" with the value "My_Access_Point", "Security Type" with a dropdown menu showing "WPA/WPA2 Passphrase", and "AWS Server Address(IPv4)" with four input boxes containing "192", "168", "1", and "100". A "Join" button is located below the form. The footer text reads "Copyright © 2014 Microchip Technology, Inc. Ver 00.07.01".

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WCM Dev Kit 1 Embedded Configuration Webpage

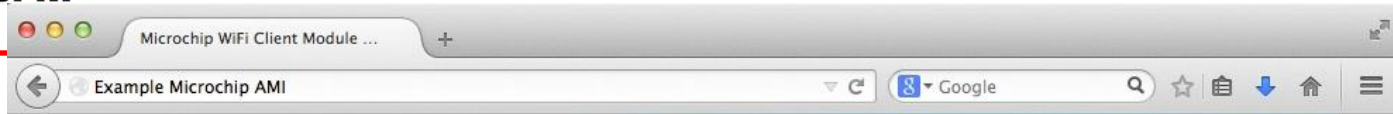
Network SSID:

Security Type:

AWS Server Address(IPv4): . . .

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Webpage



Buttons



S1



S2



S3



S4

LEDs



D1



D2



D3



D4

Potentiometer

1023

Summary

The Future is in Embedded IoT

- Advancing technologies in wireless
- Lower power and lower cost solutions
- The Internet of Things is changing the embedded world
- Smart devices and cloud connectivity create new opportunities
- Multiple wireless solutions for a given application
- Microchip provide complete solutions

**30 Billion Connected Things
by 2020**

Any Questions?





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Thank You

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