The Future of IoT

Zach Shelby
VP Marketing, IoT
Feb 3rd, 2015
Internet of (really nerdy) People – 1980s
Internet of (content silo) People – 1990s
Internet of (Web) People – 2000s
Internet of (really nerdy) Things – 1960s-1990s
Internet of (content silo) Things – 2000s

My Service

My Thing
Internet of (Web) Things – 2010s

Services

The Web

Things
By 2018, 50% of the IoT solutions will be provided by Companies which are less than 3 years old

Gartner Research, 2013
Innovation circa 2001

This Year’s Favorite Product

Information Delivered on a Plate
ARM - The Architecture for the Digital World®

From sensors to servers

10 billion

ARM-based chips, last year alone
Wide Range of Device Classes

**CLASS 0**
**ULTRA CONSTRAINED**
- ARM Cortex-M0+
- 16K RAM / 64K ROM
- Requires gateway
- Disposable, Swallowable
- RTOS or bare metal

**CLASS 1-2**
**CONSTRAINED**
- ARM Cortex-M0+/3
- 32-64K RAM / 128-256K ROM
- Direct to Internet via CoAP
- End-to-end DTLS security
- Remote management
- MBED OS support

**CLASS 3**
**MAINSTREAM IOT**
- ARM Cortex-M3/4/7
- 128K RAM / 512K ROM
- Direct to Internet
- Low-end 6LoWPAN router
- End-to-end DTLS security
- Remote management
- MBED OS, Java ME

**CLASS 4**
**RICH NODE / GATEWAY**
- ARM Cortex-A7
- 64MB RAM / 512MB ROM
- High performance node with video processing
- Rich UI
- MBED Client, Java SE, Linux, Android
IoT Requires Scale & Diversity

26 Billion Installed Units by 2020*

*Gartner
Two Key Goals for 2015

1. Create a global software ecosystem, with security!

2. Get open standards to lots of devices and services
The I in IoT: Web (and IP) Protocols to the Edge

<table>
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<tr>
<th>Application</th>
<th>IoT Application</th>
<th>Device Management</th>
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Network:
- IEEE 802.15
- 4G
- 5G
- 6G
- WiFi
- LTE
IoT connectivity for home automation

- Low-power
- Mesh network
- IP to the edge

- Wide range of devices robust & easy to deploy infrastructure sharing
- Mature end-to-end security

6LoWPAN Made Easy!
CoAP - The Web of Things Protocol

- Open IETF Standard (RFC7252)
- Compact 4-byte Header
- UDP, SMS, (TCP) Support
- Strong DTLS Security
- Asynchronous Subscription
- Built-in Discovery
- [http://coap.technology](http://coap.technology)
ARM and Oracle are bringing CoAP support to OpenJDK

Project Kona

- Java APIs and protocols for IoT
- Embedded devices in particular

CoAP contribution from ARM is planned for next week 😊

Project Lead: Riaz Aimandi (Oracle)

Lead Committer: Szymon Sasin (ARM)
A Keynote Challenge!

- Write a CoAP client to interact with me in real time
  - Discover my question
  - GET the question
  - PUT your answer (and your name!)

- Server location: coap://192.168.80.121
- Hint: Californium is great for Java Nerds
- Hint: Copper is awesome, but cheating!
- Free mbed IoT development board for first to finish
Common OS and Connectivity Across Markets

**Smart Cities**
- Application
- Sub-GHz
- Zigbee IP-NAN Connectivity
- Provisioning
- Security
- OS + Drivers

**Smart Home**
- Application
- WiFi
- BT Smart Connectivity
- Thread
- Provisioning
- Security
- OS + Drivers

**Wearables**
- Application
- BT Smart Connectivity
- Provisioning
- Security
- OS + Drivers
Common OS and Connectivity Across Markets

Smart Cities
- Application
- Common software foundation
- Monitoring
  - Security
  - OS + Drivers
- Provisioning
- Security
- OS + Drivers

Smart Home
- Application
- Common software foundation
- Monitoring
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Wearables
- Application
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- Provisioning
- Security
- OS + Drivers

Similar key connectivity standards
- Sub-GHz
- Zigbee IP-NAN
- Zigbee
- IP-NAN
- WiFi
- BT Smart
- Thread
- BT Smart
- Connectivity

Common OS and Connectivity:
- Zigbee
- IP-NAN
- Sub-GHz
- WiFi
- BT Smart
- Thread
mbed Ecosystem
Developers and partners making use of mbed technology

mbed Device Server
Software that enables services to manage mbed Enabled things.

mbed OS
Free operating system for low-power devices. Just add App.

ARM Cortex®-M based MCU
The new mbed Partner Ecosystem: Join Us!
From Idea to Product
mbed OS Roadmap 2015

- Minimize time-to-market
- Low-power by design
- Complete security solution
- Top connectivity standards
- Built-in device management

Applications

- mbed OS C++ APIs
- Communication Management
- Device Management: LWM2M
- Event Framework
- Tasks
- CMSIS-Core

Community Libraries

- Cryptobox
  - Asset Protection, Crypto, Key Management, Secure Bootloader

- ARM Cortex®-M -based MCU
- Sensors
- Radio

- Application: CoAP, HTTP, MQTT
- Security: TLS, DTLS
- IPv4
- IPv6, 6LoWPAN

Built-in device management

Top connectivity standards

Complete security solution

Low-power by design

Minimize time-to-market
mbed OS Release Schedule

Alpha 1
mbed Partners
Dec '14

Alpha 2
mbed Partners
Mar '15

Alpha 3
mbed Partners
Jun '15

Beta
Public
Aug '15

Release 3.0
Public
Nov '15

Release 3.1
Public
Feb '15

Apache 2.0

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Java on mbed

Native C++

Application

mbed OS

Application

Java ME

mbed OS
Embedded software: Scaling with mbed and Java

Drive platform consistency, developer productivity, and software intelligence

- **Reduce** embedded platform fragmentation and time-to-market
- **Enable** Java Embedded on a growing range of mbed-enabled devices
- **Combine** the strengths of the mbed and Java communities and partners
Freescale FRDM-K64F
Versatile, simple-to-use ARM Cortex-M4 MCU platform

- Java ME Embedded 8.1 Developer Preview
  - Freescale FRDM-K64F
    - Kinetis K64F, 120 MHz, 256 KB RAM/1 MB Flash, ARM mbed
    - Arduino form-factor and pin-out. Approx. $25 street price
  - Brings Java 8 to Micro-Controllers
    - Optimized Java ME 8 runtime in 190 KB RAM, enabling highly functional Java Embedded applications on single-chip micro-controller systems
    - Java 8 language, core APIs, networking, device I/O, storage, and more
    - Simple installation and development via Java ME SDK 8.1, NetBeans and Eclipse IDEs
    - Complements existing Java ME 8 platforms such as Raspberry Pi, scaling Java ME 8 from large to small
    - Ideal for evaluation and prototyping
- FREE download via Oracle Technology Network (OTN)
mbed Device Server

- Straightforward integration
- Periodic connectivity support
- Complete managed security
- Leading open standards
- Lightweight management

**mbed Device Interface** - Open Web Standards

**Application Transfer Protocols** – CoAP, HTTP, MQTT

**Security Protocols** – DTLS, TLS

**Directory and Subscription**

**Security, Admin and Multi-tenancy**

**Device Management and Data Flows** - RESTful and Publish/Subscribe

**mbed Device Server API**
Toast and Espresso
Big Data Starts with Little Data

Devices Layer
- Little Data
- mbed
- Device
- Server

Data Layer
- Big Data
- Java Application
- MongoDB
- Microsoft Azure
- Real Time Query

Presentation Layer
- User Sessions
- HTML Application
- App
- Browser

Network
- 100's Servers
Big Data Starts with Little Data

**Device Layer**
- **Little Data**
- **mbed Device Server**
- **1,000,000,000’s Devices**

**Data Layer**
- **Java Application**
- **mongodb**
- **Big Data**
- **10’s Servers**
- **100’s Servers**
- **1,000,000,000’s Devices**

**Presentation Layer**
- **User Sessions**
- **HTML Application**
- **10,000,000’s Clients**
- **App**
- **Browser**
- **100’s Servers**
So What Was the Future of IoT?

You
Learn more!

http://mbed.com
http://coap.technology
http://threadgroup.org
@zach_shelby