Deploy Small IoT Embedded SOC Devices and a Back-End Platform with Java, Using WaRP

CON10282 - 10/28/15 (Wednesday) 11:30 AM - Hilton—Continental Ballroom 7/8/9

Presenters:

Nicola La Gloria - Kynetics

Aaron Oki Moore - Revolution Robotics

Presenter Background

Nicola La Gloria, Kynetics, CEO

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Aaron Oki Moore, Revolution Robotics (REVO), President

aaron@revoinc.com

Today's Topic

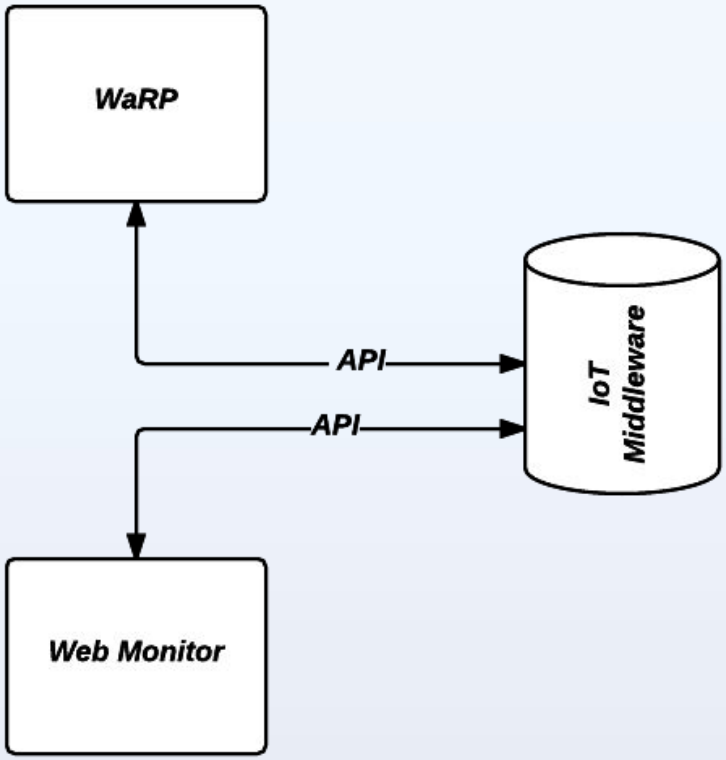
Deploy Small IoT Embedded SoC Devices and a Back-End Platform with Java, Using WaRP

Goal of this session:

- Share the process of developing a Java capable hardware platform (WaRP)
- Learn how to access hardware sensors from Java
- How to send data from embedded devices to the cloud (including bi-directional communication)

Today's Topic

What we will be showing



Agenda

- ~~Introduction & Background~~
- Hardware
  - Embedded Hardware in IoT
  - WaRP Hardware Overview
  - Prototyping sensor hardware using WaRP
- Software
  - System Architecture
  - Java Software for Sensor Data Collection
  - Edge IoT Middleware
- Demo

Embedded Hardware in IoT

- Embedded Devices are (typically) End Devices or Gateways
- Devices at the edge have the role of controlling or collecting data

Data Generators

- Medical Sensors (EKG)
- Security Systems (Motion)
- Temperature Sensors (HVAC)

Controllers / Data Consumers

- Industrial Controls (Scada / Automation)
- Home Automation (HVAC / Door Locks)

Embedded Hardware in IoT

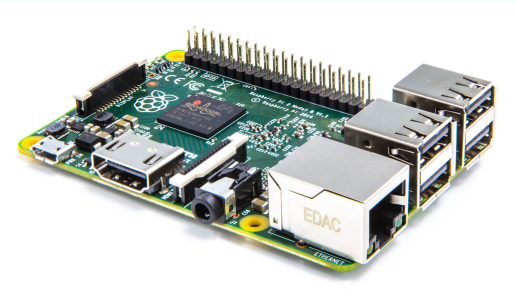
- Embedded means we're dealing with small platforms and different System Architectures
  - ARM / PowerPC vs Intel x86

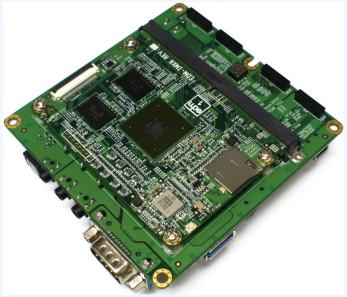
- Small
- Reasonably fast
- Inexpensive

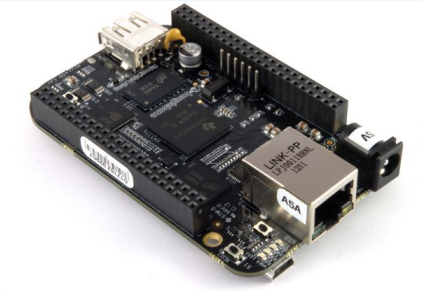
- For this presentation we'll be looking at ARM SoC/APs not MCUs
- Java SE Embedded

Embedded Hardware in IoT

Raspberry Pi / Beagle / Wandboard / C.H.I.P

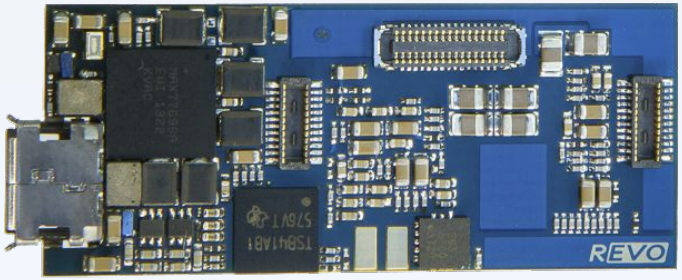






SoC Reference Platforms: Freescale Saber, Nitrogen

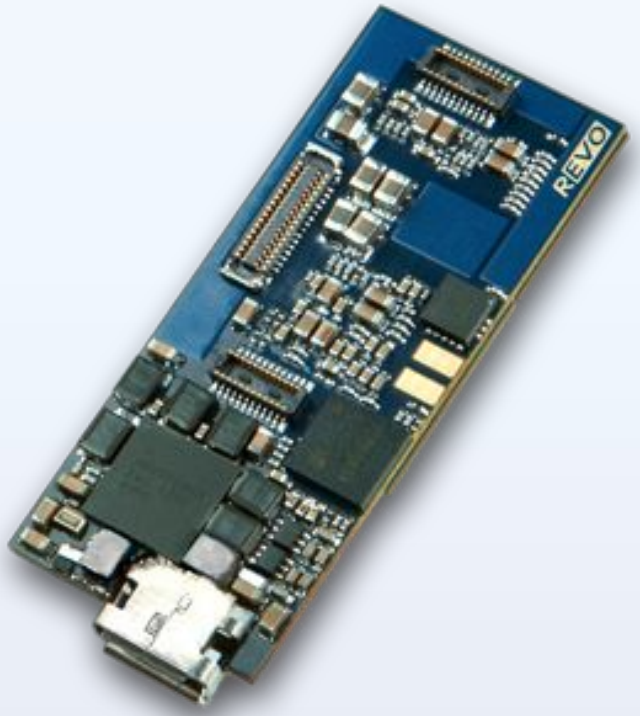
WaRP Hardware Overview



- WaRP - Wearable Reference Platform
- We designed as a Reference Platform for Wearable Computing and highly embedded / small devices
- Consequently works great as an IoT platform
- Performance and size comparable to cell phones
- Totally Open Source

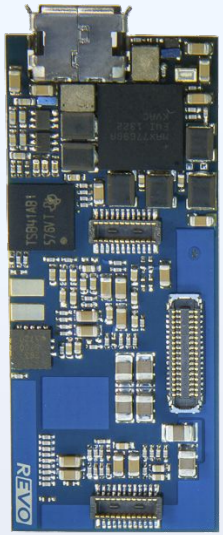
WaRP Hardware Overview

- Specs
  - Based on Freescale i.MX6 ARM Cortex-A9
  - 512MB DDR2 Memory
  - 4GB eMMC Flash Storage
  - WiFi - 802.11 b/g/n + BT
  - Built-in Power Management
  - LCD & E-ink display support
  - USB and IO expansion
  - and more



WaRP Hardware Overview

Hybrid Design Architecture - allowing developers to expand the platform easily



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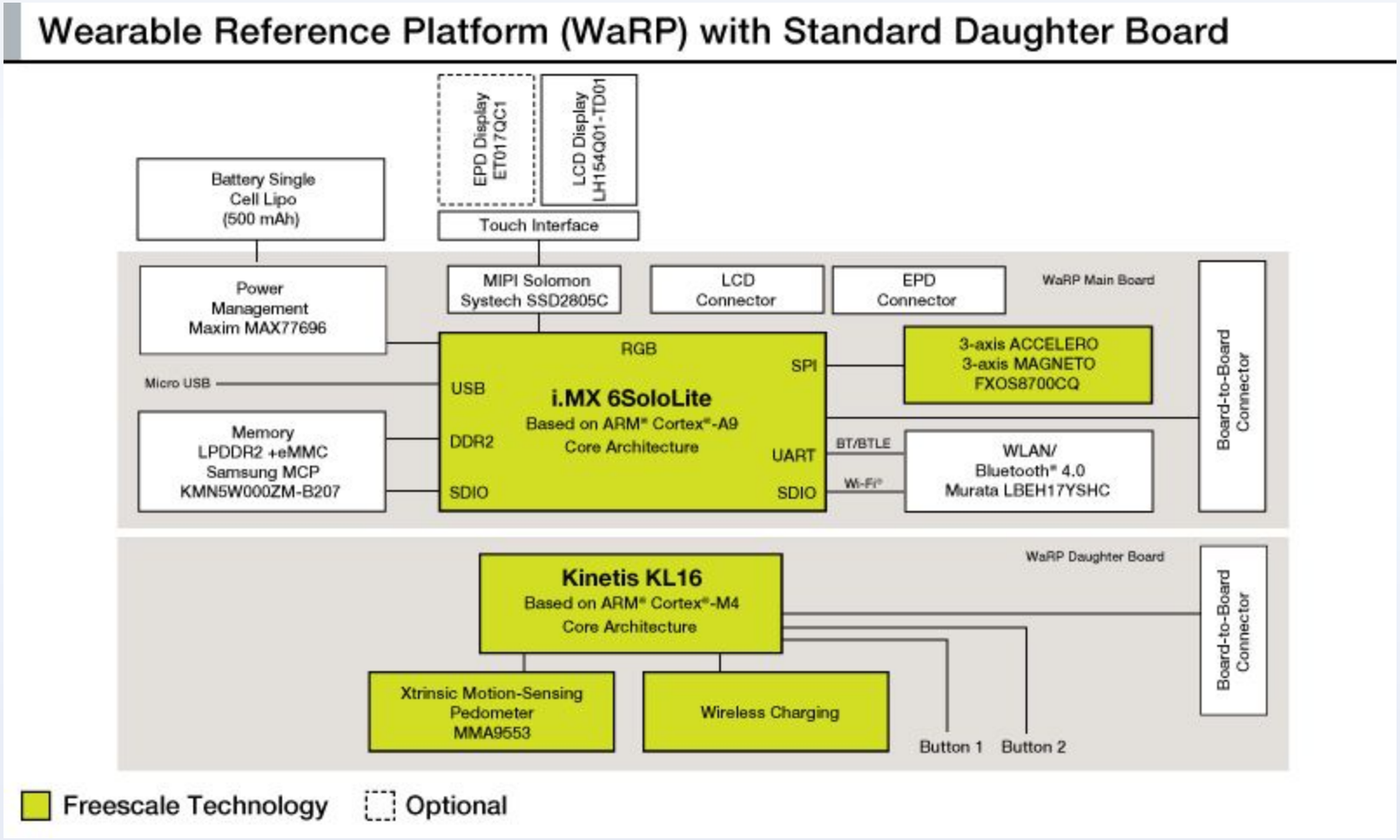
Application Specific Hardware

(Sensors)

WaRP Hardware Overview



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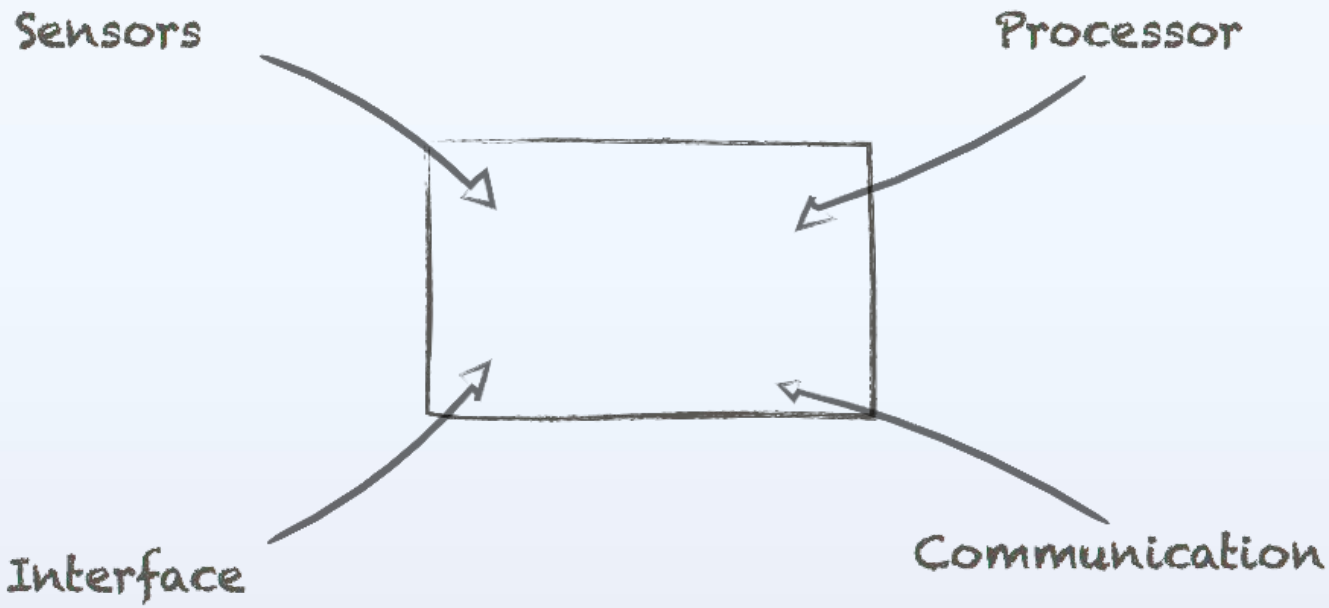
Prototyping sensor hardware using WaRP

Anatomy of a Hardware Design



Prototyping sensor hardware using WaRP

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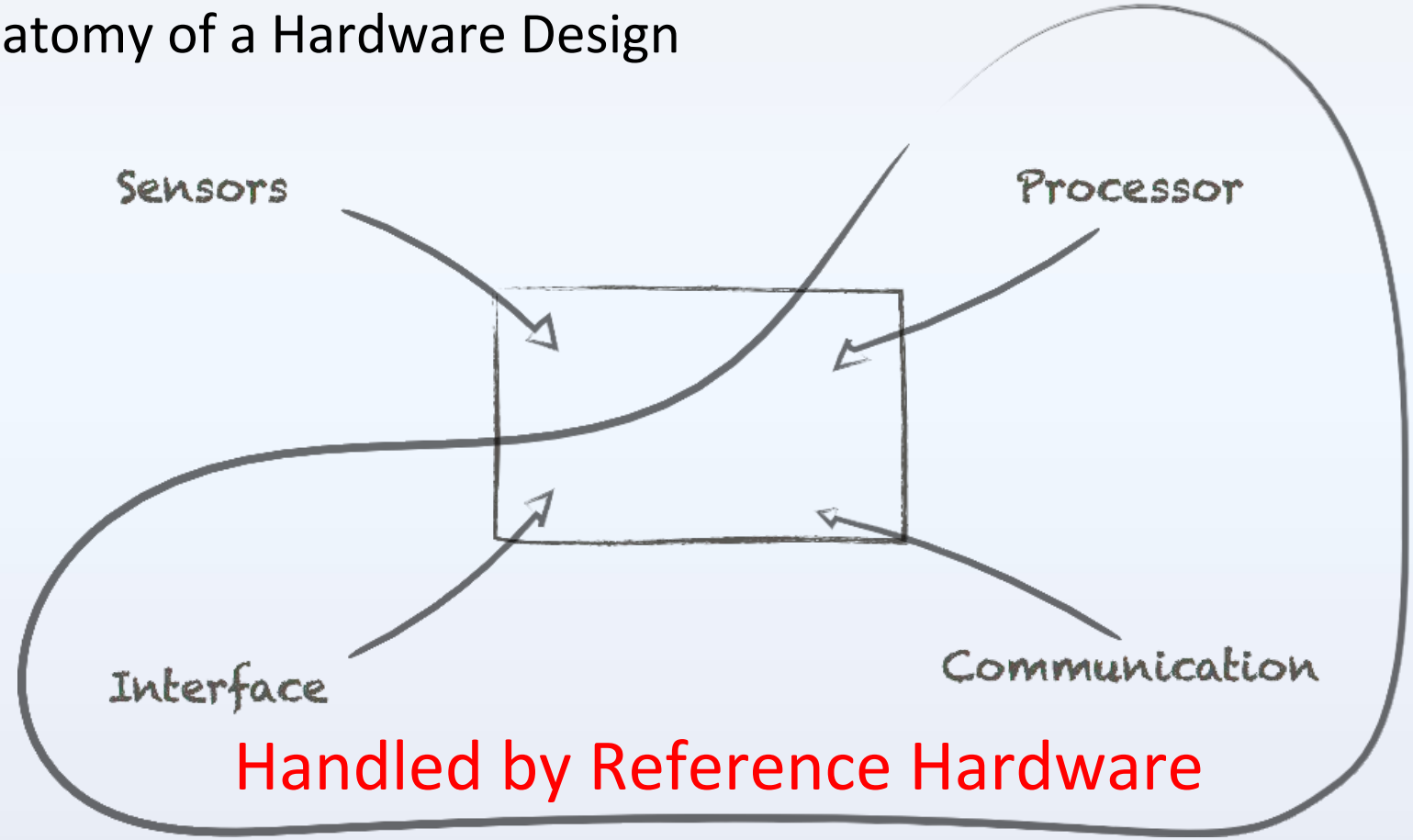
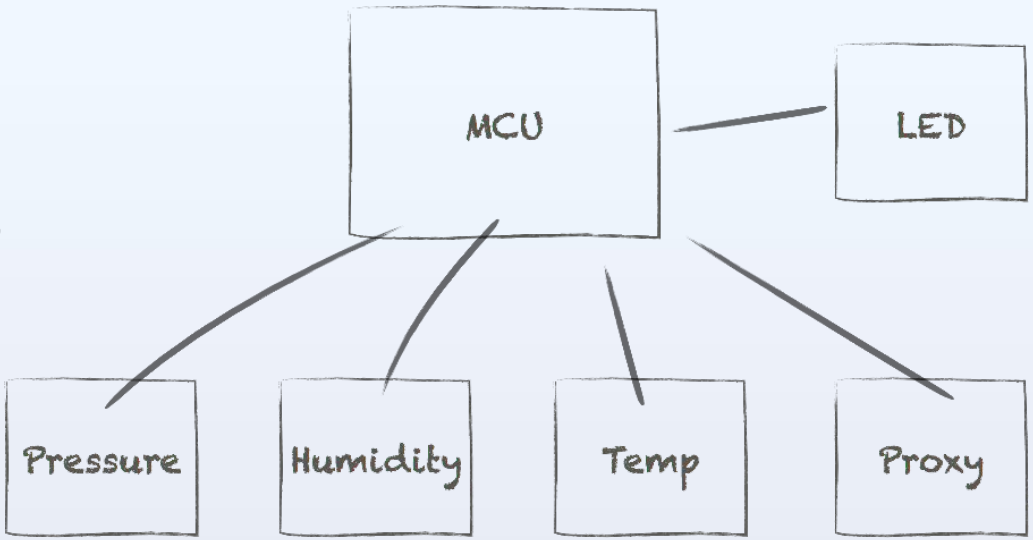


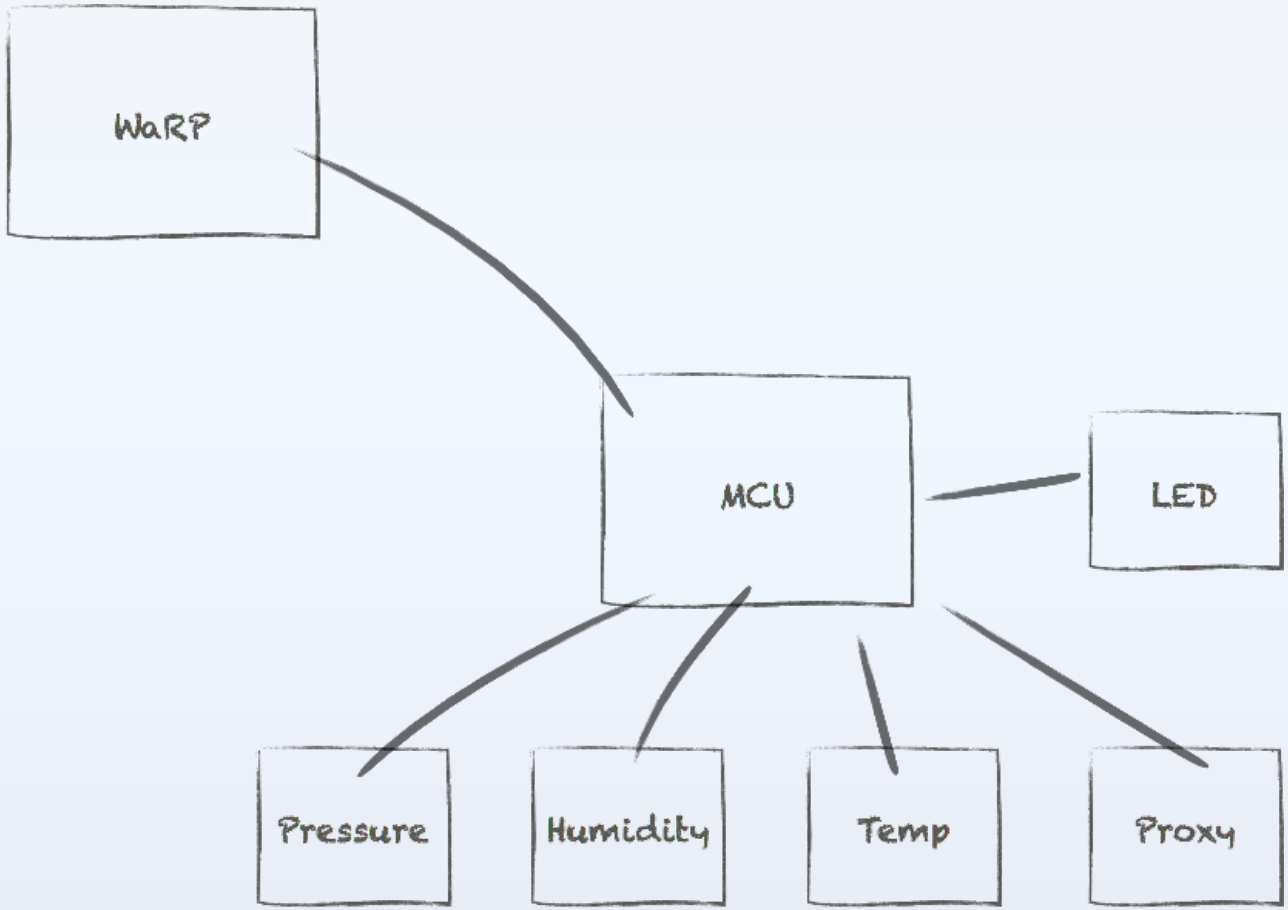
Prototyping sensor hardware using WaRP

Sensor Block Overview

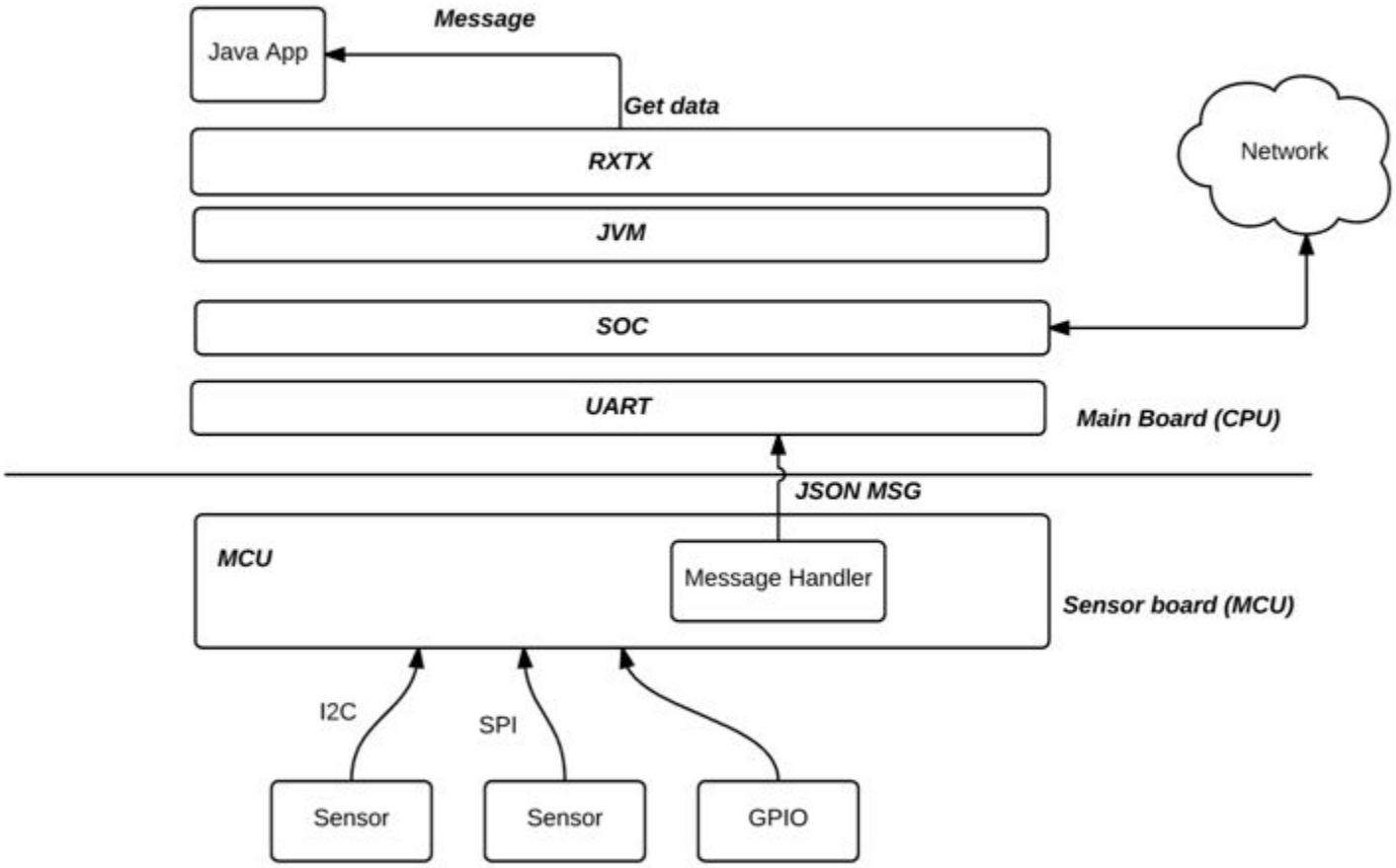
- Series of Environmental Sensors
  - Pressure
  - Humidity
  - Temperature
- Control a Status LED



Prototyping sensor hardware using WaRP



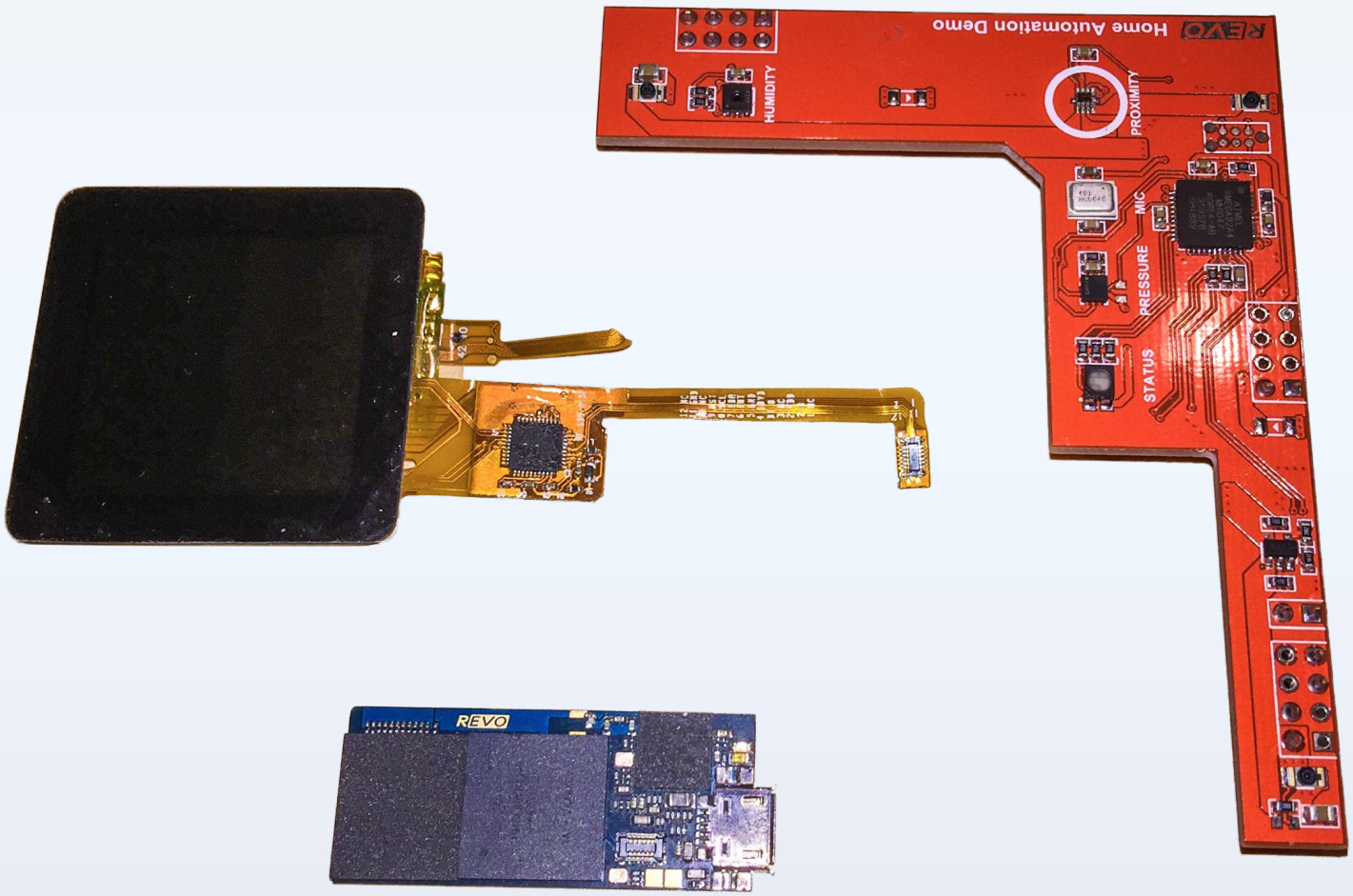
Prototyping sensor hardware using WaRP



Prototyping sensor hardware using WaRP

Schematic.pdf

Prototyping sensor hardware using WaRP



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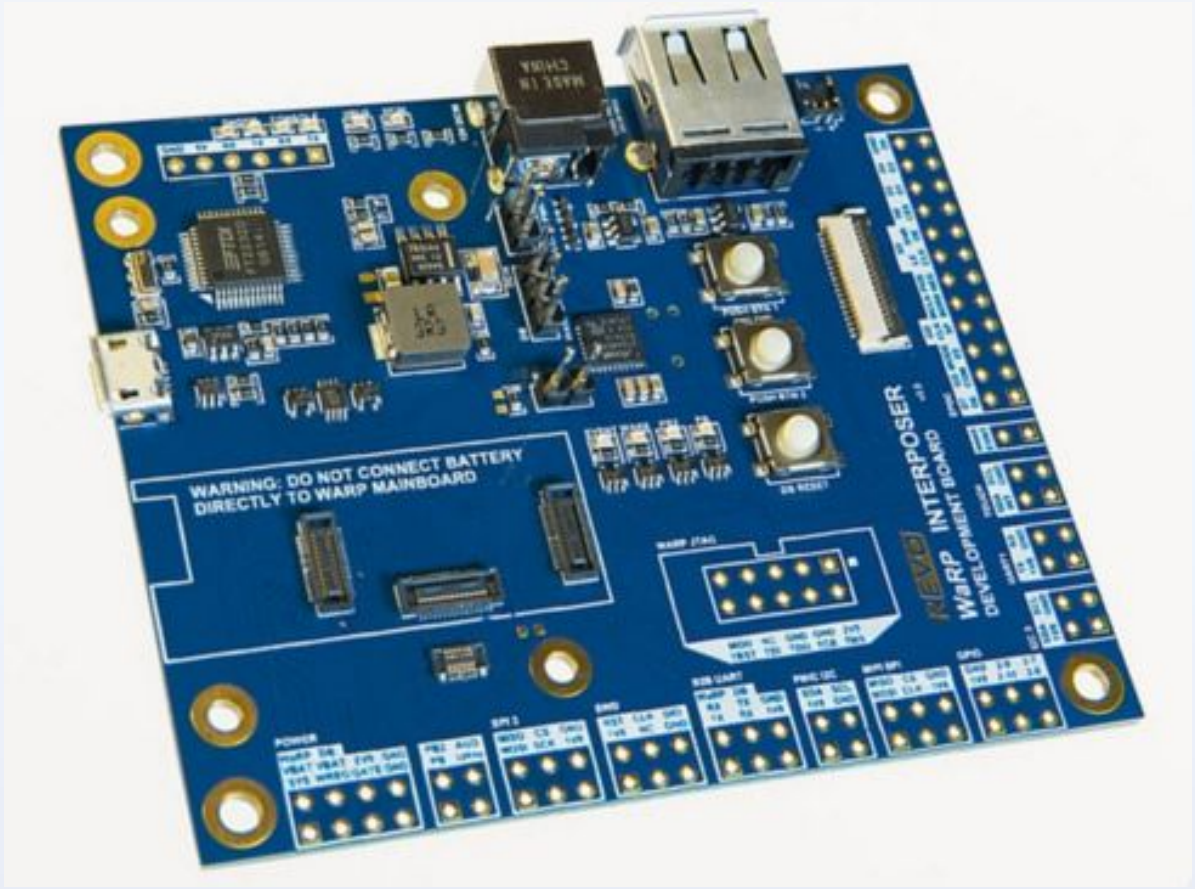
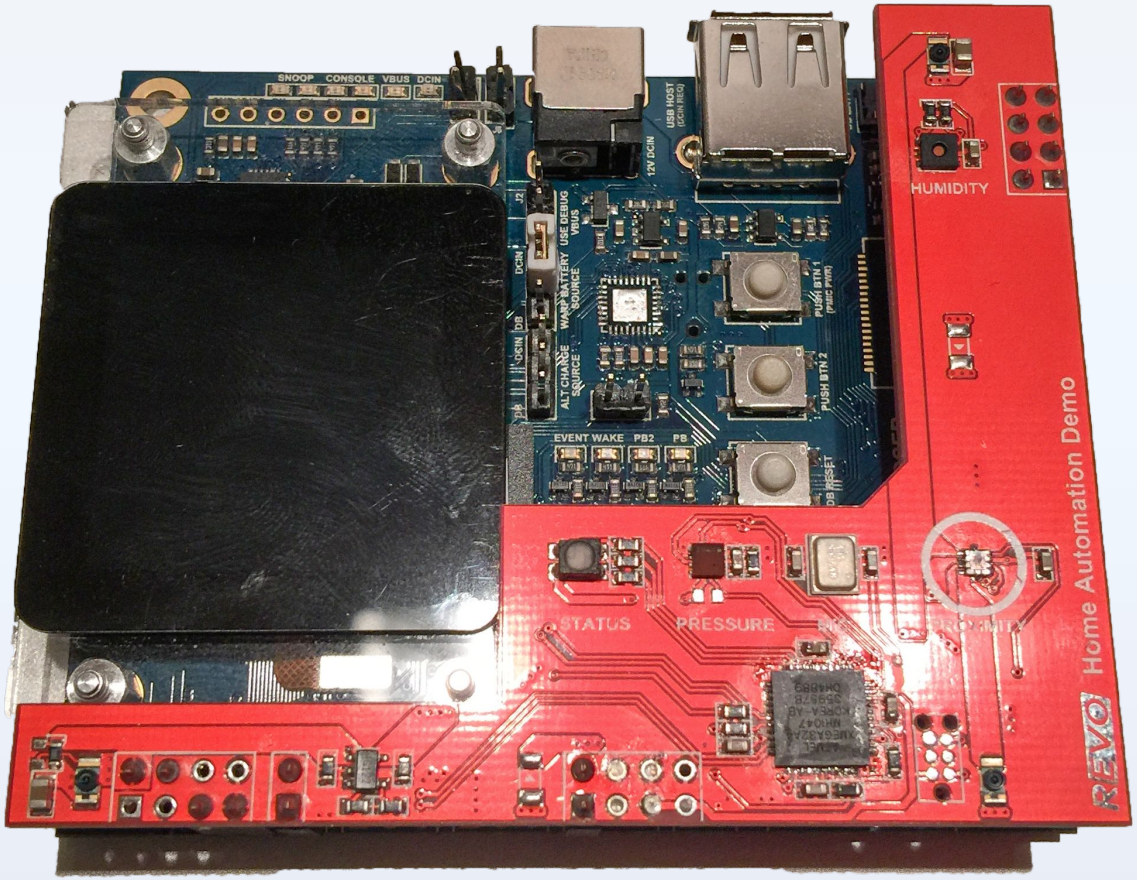
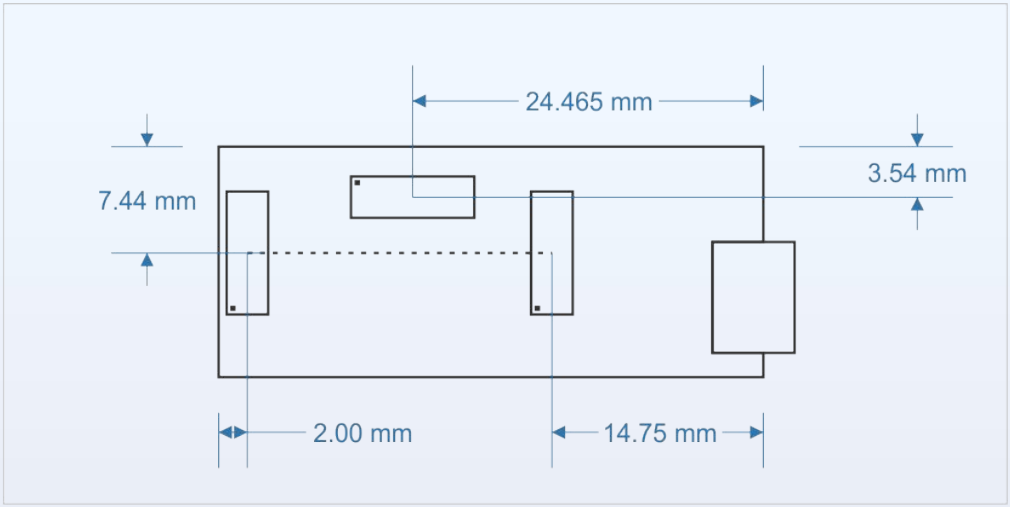


Prototyping sensor hardware using WaRP



Prototyping sensor hardware using WaRP

Only requirement for creating a custom daughter board is to follow the footprint for the WaRP Mainboard connectors.



Prototyping sensor hardware using WaRP

Key Points

- Add application specific hardware to existing dev / reference platforms
- Separate hardware from software domains to minimize dev pains
- Use of human readable data streams makes development easier
- Expansion Hardware could be as easy as using an Arduino
- MCU is running native code today (not Java, but CAN be Java)
- MCU runs independent of the rest of the system to deliver the data

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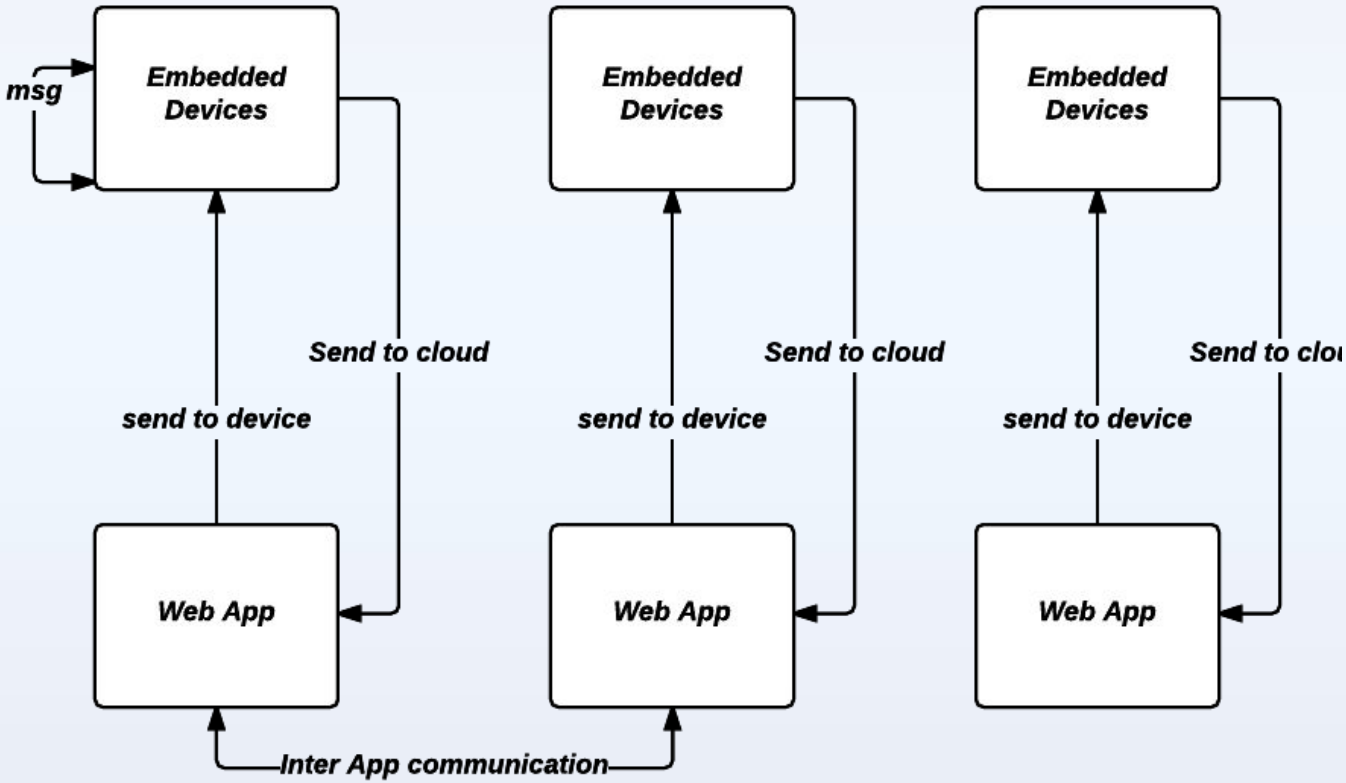
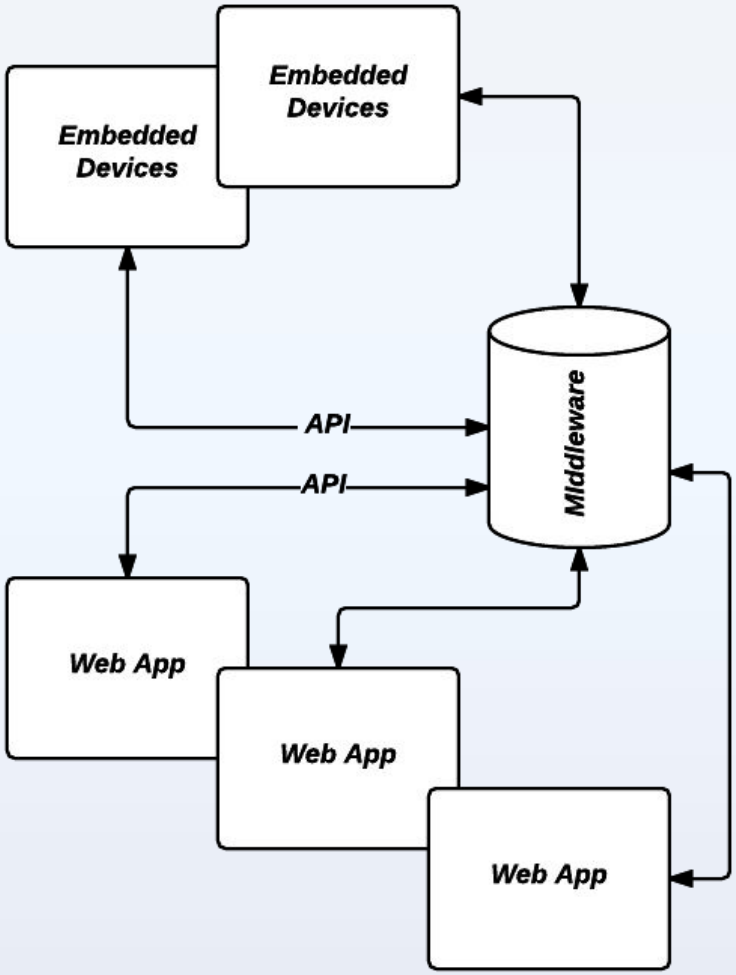
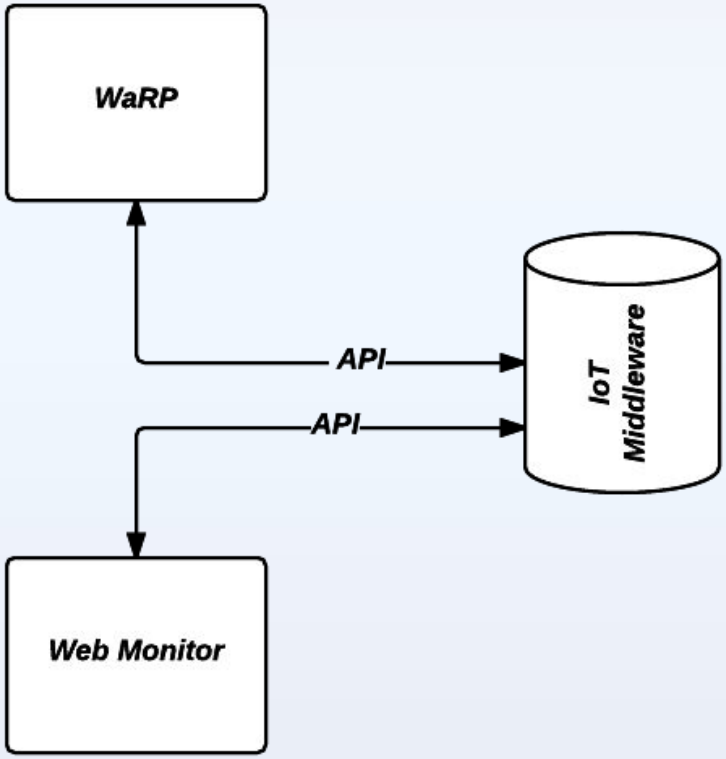
System Architecture - Our Problem



System Architecture - Our Solution



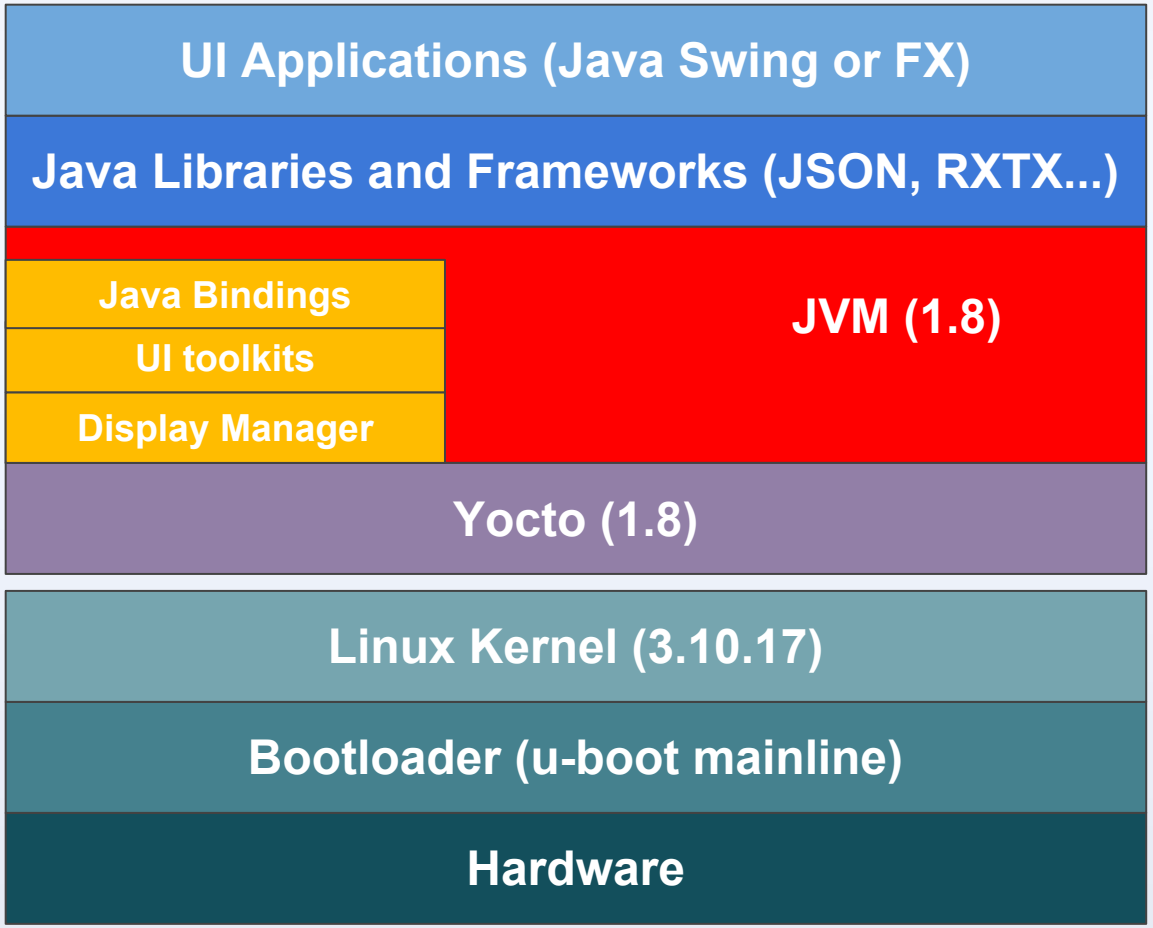
System Architecture - Demo



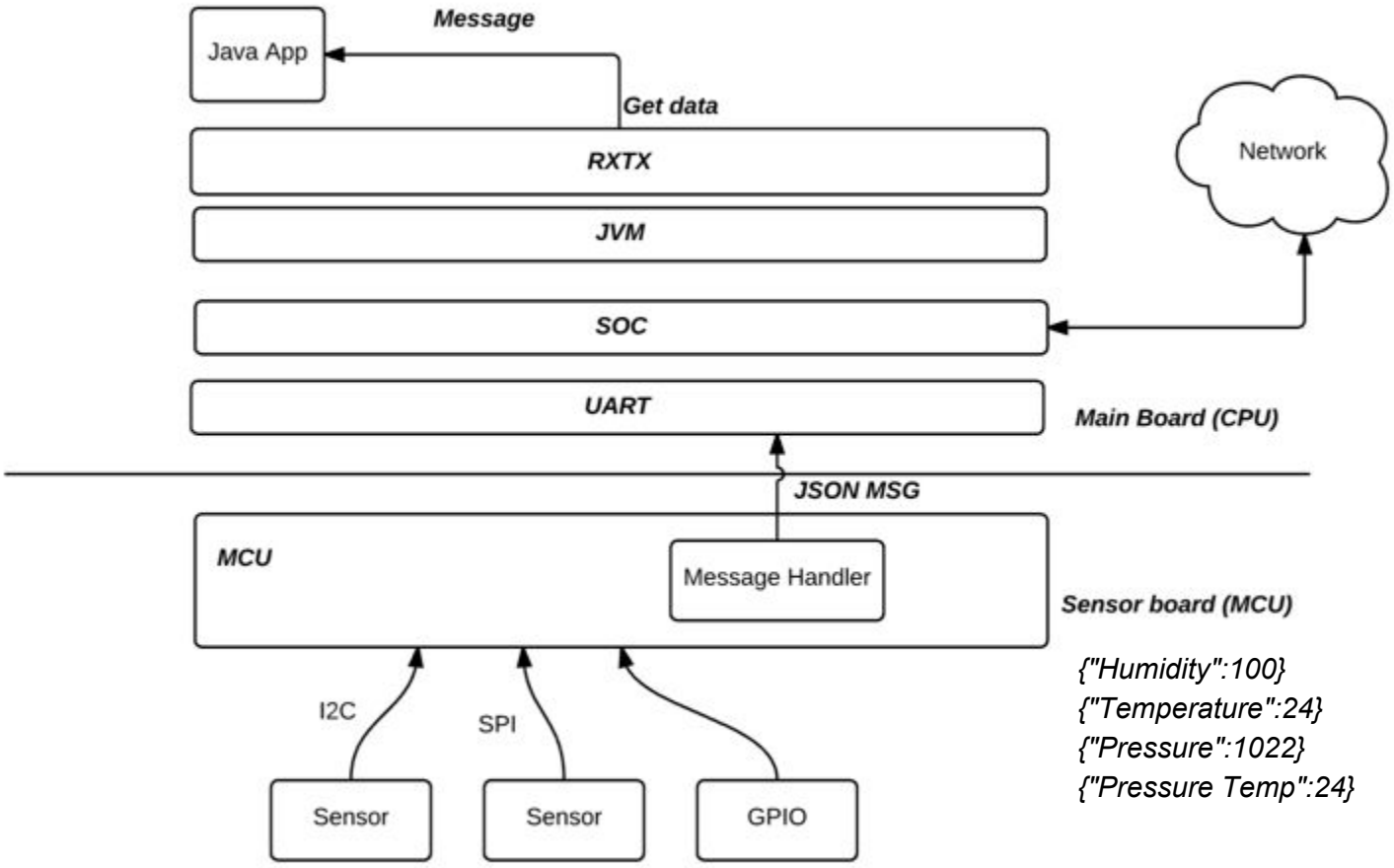
System Architecture - Frameworks

- **Embedded device**
  - Java SE 8
  - RXTX
  - Connector to IoT Middleware (REST API handler)
  - Java Swing application (or JFX)
- **Edge (IoT middleware)**
  - Spring
  - H2 or MySQL database
  - Groovy (Initialization scripts)
- **WebApp**
  - Groovy, JQuery, HTML, CSS

System Architecture - Embedded System Overview



Java Software for Sensor Data Collection



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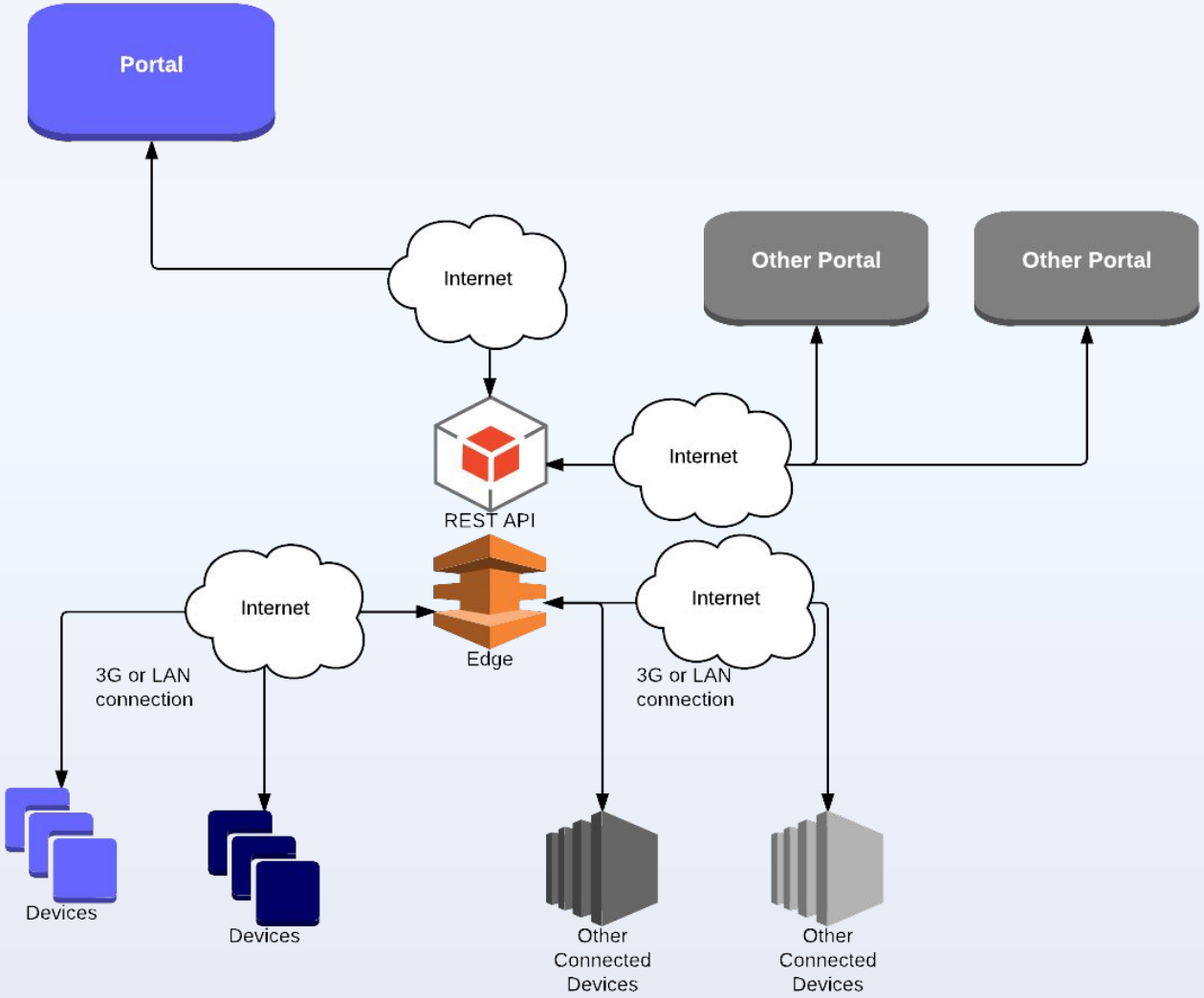
Edge IoT Middleware - Overview



Edge IoT Middleware - Entities

Edge is a lightweight middleware that allows to manage

Application Entities:

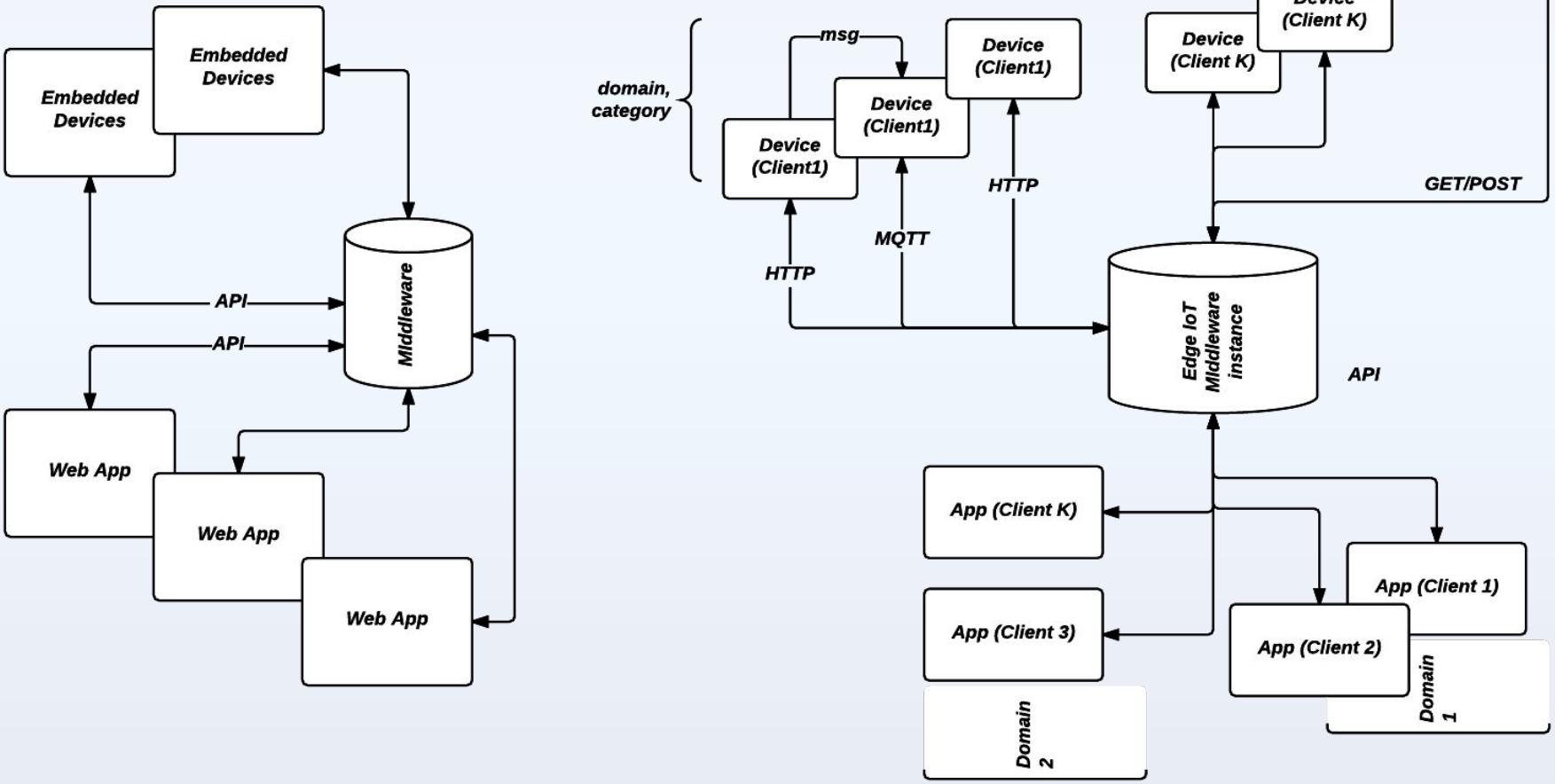
- Client (a “Customer” allowed to use the system)
  - belong to a domain
- Device (a device that belongs to a Client)
  - belong to a domain
  - handle values
  - belong to a category
- File
- Message (from device to device)

Edge IoT Middleware - Entities

Authentication and Authorization Entities :

- User
- Role (that can be assigned to a user)
- Rule (what a role is allowed to do on the system)
  - actions (use cases)
  - agent (handles the actor of the use case: device, client, all)
  - resource (the target entity of the use case, i.e a file)
  - domain

Edge IoT Middleware - Architecture



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  - ~~IoT Device to Cloud Architecture~~
  - ~~Edge IoT Middleware~~
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DEMO - Setup

- **Interposer board**
  - provide serial console to u-boot
    - flash OS image
    - set boot parameters
    - boot the system!
- **WaRP: Embedded OS**
  - ethernet gadget for networking
  - JVM
  - sshd
    - access to console
    - deploy gradle build (distTar, with all conf files and jars)
  - serial monitor tool (screen)
  - sensor emulator (generate fake data, useful during development)
  - rxtx for serial communication
- **IoT middleware (Edge IoT)**
  - server running in local on linux desktop (H2, in memory DB)
  - REST APIs
- **Client**
  - Browser

Links & Resources

Community website:

- www.warpboard.org

Repository:

- https://github.com/orgs/warpboard

Software and documentation resources:

- www.kynetics.com/download/WaRP/
- www.revotics.com/warp/downloads

Components:

- AVNET link to buy WaRP
- WaRP Interposer Dev Board

Q & A

Thank you!

A special thanks to:

- Our teams at REVO and Kynetics
- James Allen (Oracle)
- Eric Nelson (former Boundary Devices now Nelson Integration)
- David Clack (former Sun / Oracle)

WaRP Kit Contents