

IoT
Anything from Anywhere
With the Internet of Things

Scotty Cowling, WA2DFI

2016 TAPR/ARRL Digital Communications Conference
September 2016, St Petersburg, FL



Apple supports Windows?



©2016 Scotty Cowling WA2DFI

What is the IoT?

and why can't you capitalize it right?

Internet of Things

Defined in Recommendation

ITU-T Y.2060, sec 3.2.2

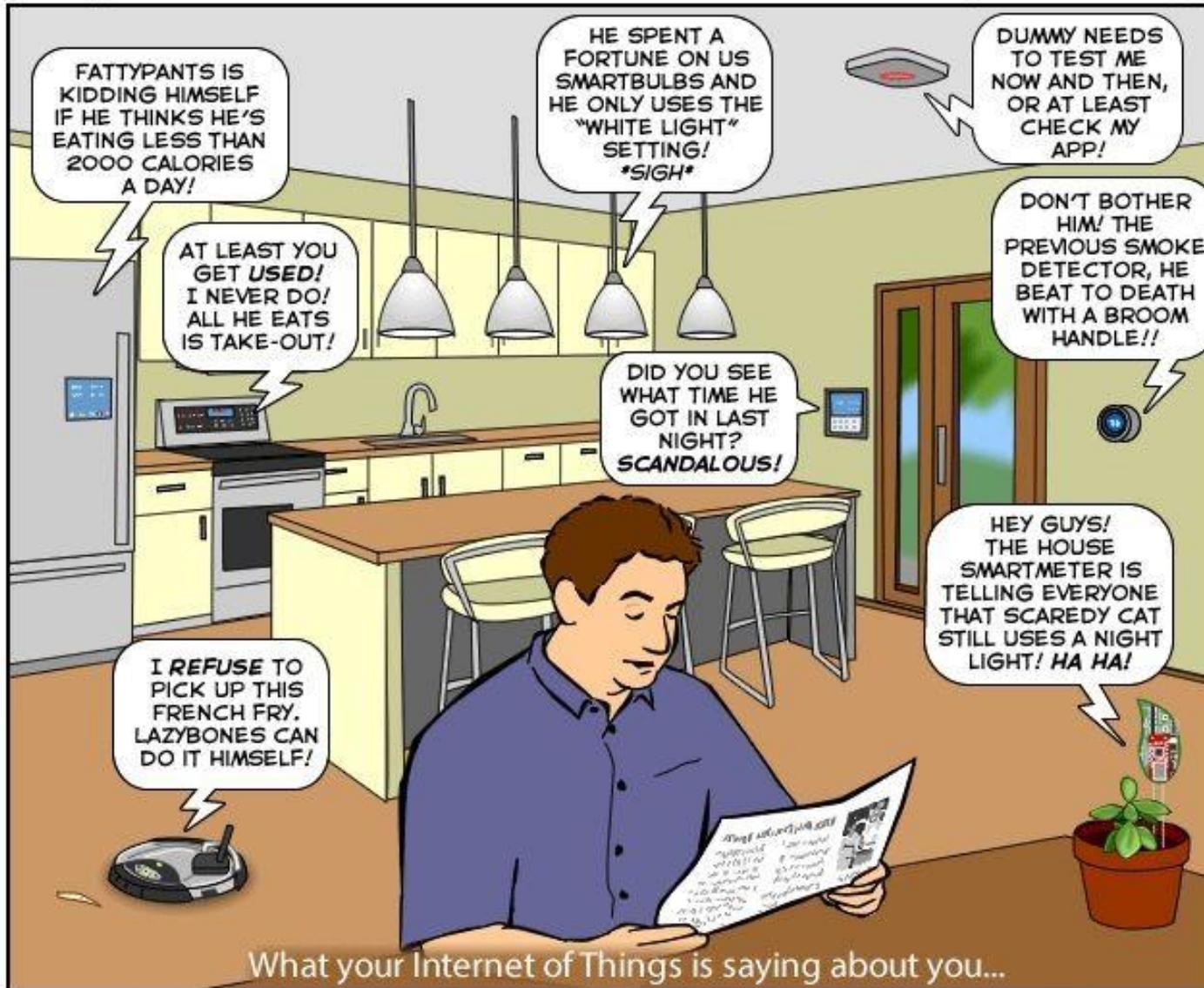
A *system* of interrelated computing *devices* provided with unique identifiers and ability to *transfer data* over a *network* without human interaction.



Brave New World?

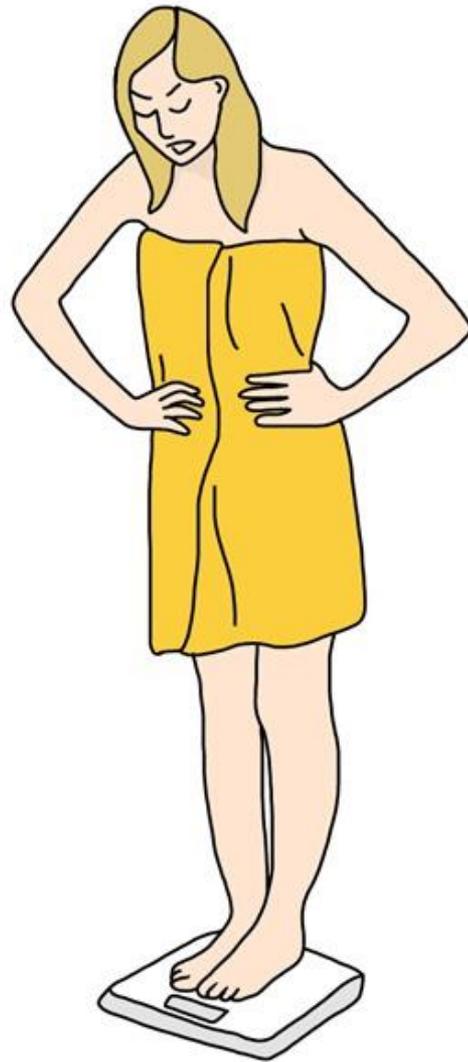
Maybe...





What your Internet of Things is saying about you...





*“Bad news - the scale is threatening to cut off
our access to the fridge...”*



Typical DCC-inspired Project



©2016 Scotty Cowling WA2DFI

Possible Result if you Don't Pay Attention



©2016 Scotty Cowling WA2DFI

IoT – the Big Picture

Components of IoT

- devices
- data
- network
- storage
- access



IoT – the Big Picture

Components of IoT

- **devices**
 - data
 - network
 - storage
 - access
 - sensors
 - servos
 - displays
 - motors
 - processors
 - nuclear reactors
 - nanobots
- 



IoT – the Big Picture

Components of IoT

- devices
 - data
 - network
 - storage
 - access
- 
- temperature
 - time
 - velocity
 - orientation
 - elevation
 - audio/video
 - ... just numbers



IoT – the Big Picture

Components of IoT

- devices
 - data
 - **network**
 - storage
 - access
- 
- WAN, LAN
 - Bluetooth
 - Ethernet
 - cellular network
 - WiFi
 - mesh networks
 - *typically wireless*



IoT – the Big Picture

Components of IoT

- devices
 - data
 - network
 - **storage**
 - access
- 
- cloud servers
 - NAS
 - distributed
 - persistent
 - backed up
 - secure (or not!)
 - multiple access



IoT – the Big Picture

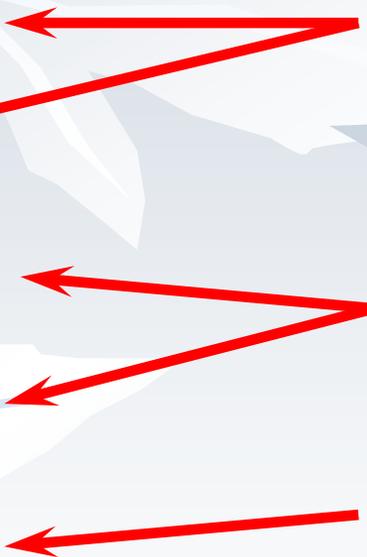
Components of IoT

- devices
 - data
 - network
 - storage
 - **access**
- 
- Web browsers
 - custom GUIs
 - raw data ports
 - remote servers
 - devices
 - other devices
 - network gateways



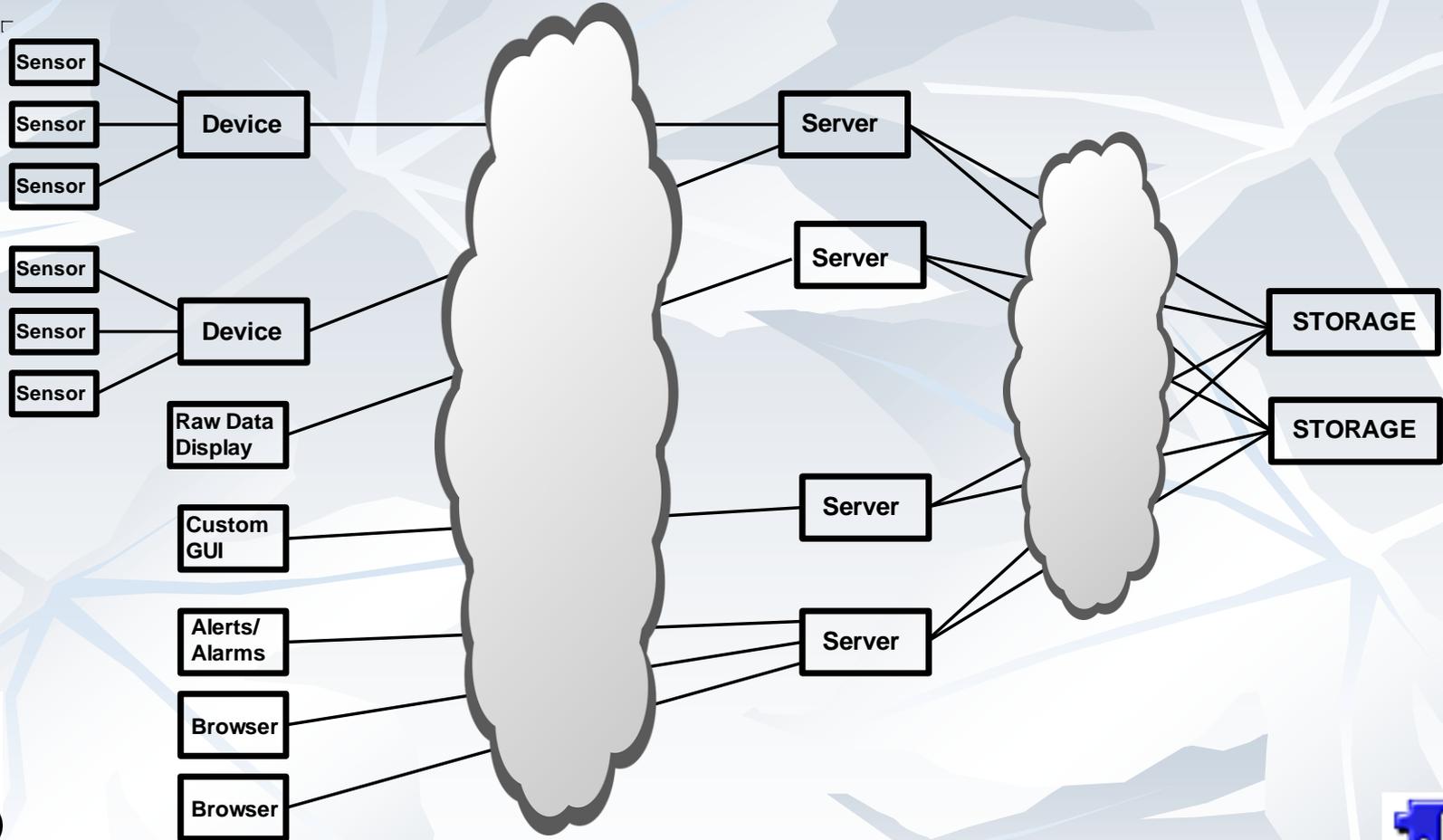
IoT – the Big Picture

Components of IoT

- **devices**
 - **data**
 - **network**
 - **storage**
 - **access**
- We get to make this
- These exists already!
- So does most of this!
- 



IoT – One Implementation



Leaky Clouds



The Project: Goals

Hardware

- Renesas Synergy SK-S7G2 Board
 - Custom Arduino sensor board
 - AMS 5-way sensor PMOD
 - WiFi PMOD
 - 4G LTE CAT1 modem PMOD
 - Vibration motor
 - USB drive, ear buds



The Project: Goals

Software

- Use existing e2Studio IDE, SSP
- Custom Arduino sensor board
- Five Lab exercises to demonstrate
 - Local control and sensor display
 - Cloud connectivity via WiFi
 - Cloud connectivity via 4G LTE
 - BLE connectivity



The Project: Goals

Lab Exercises

- Lab 1: WiFi and AMS proximity sensor
 - Lab 2: MP3 player
 - Lab 3: multi-sensor
 - Lab 4: Bluetooth connectivity
- Lab 5: Multiple board connectivity



The Project: Goals

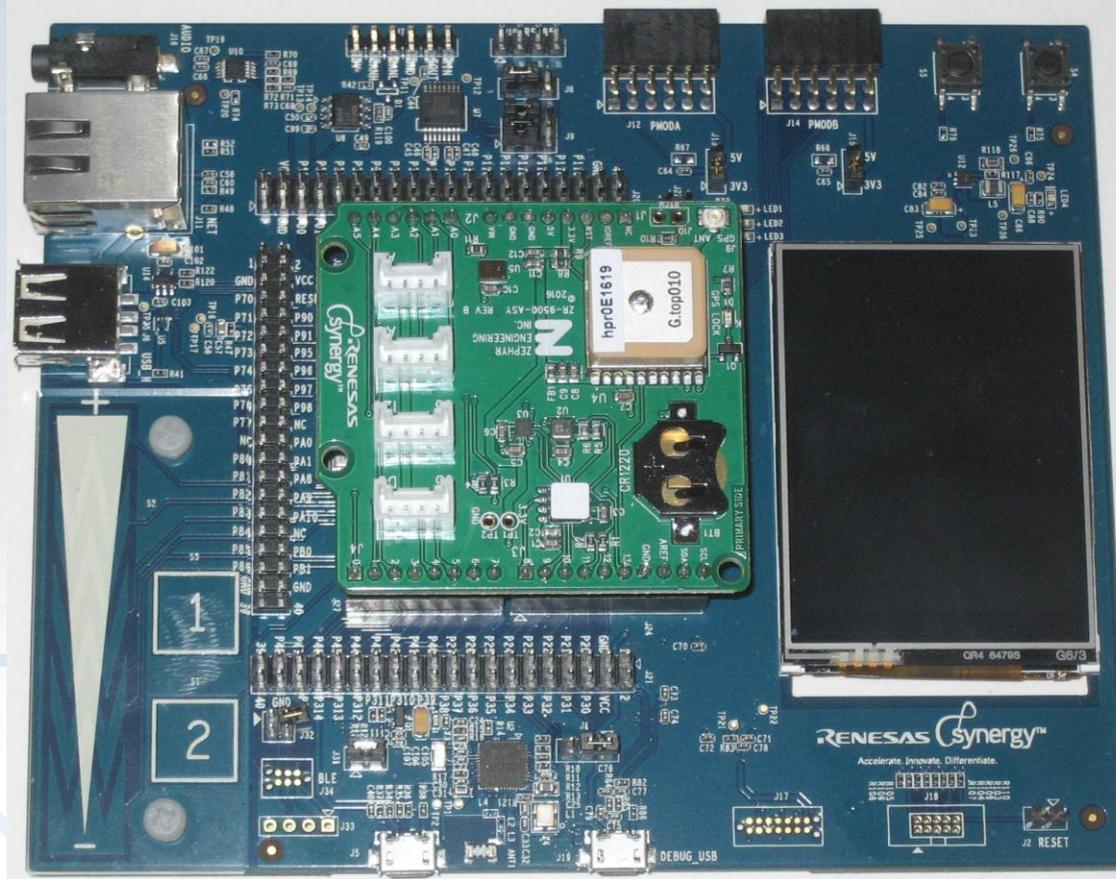
Lab Exercises

Labs must show examples of:

- Local sensor data display
- Display or control of data in the Cloud
- Bluetooth to connect a sensor
- Access multiple boards in one GUI
- Show use of Verizon's Freeboard Dashboard



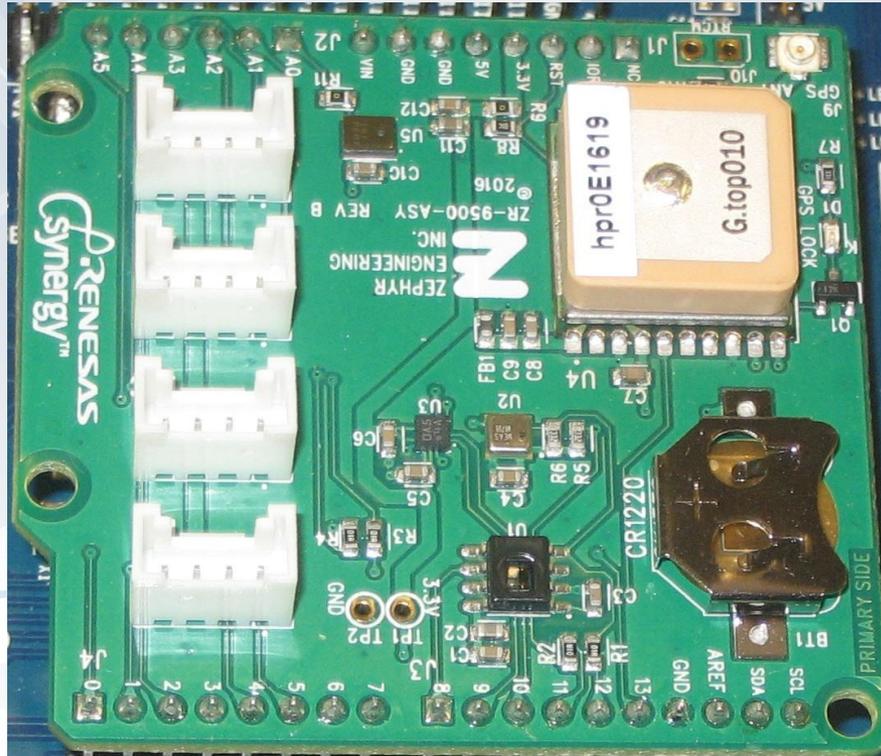
Hardware (device)



Renesas Synergy SK-S7G2 Board



Hardware (device)

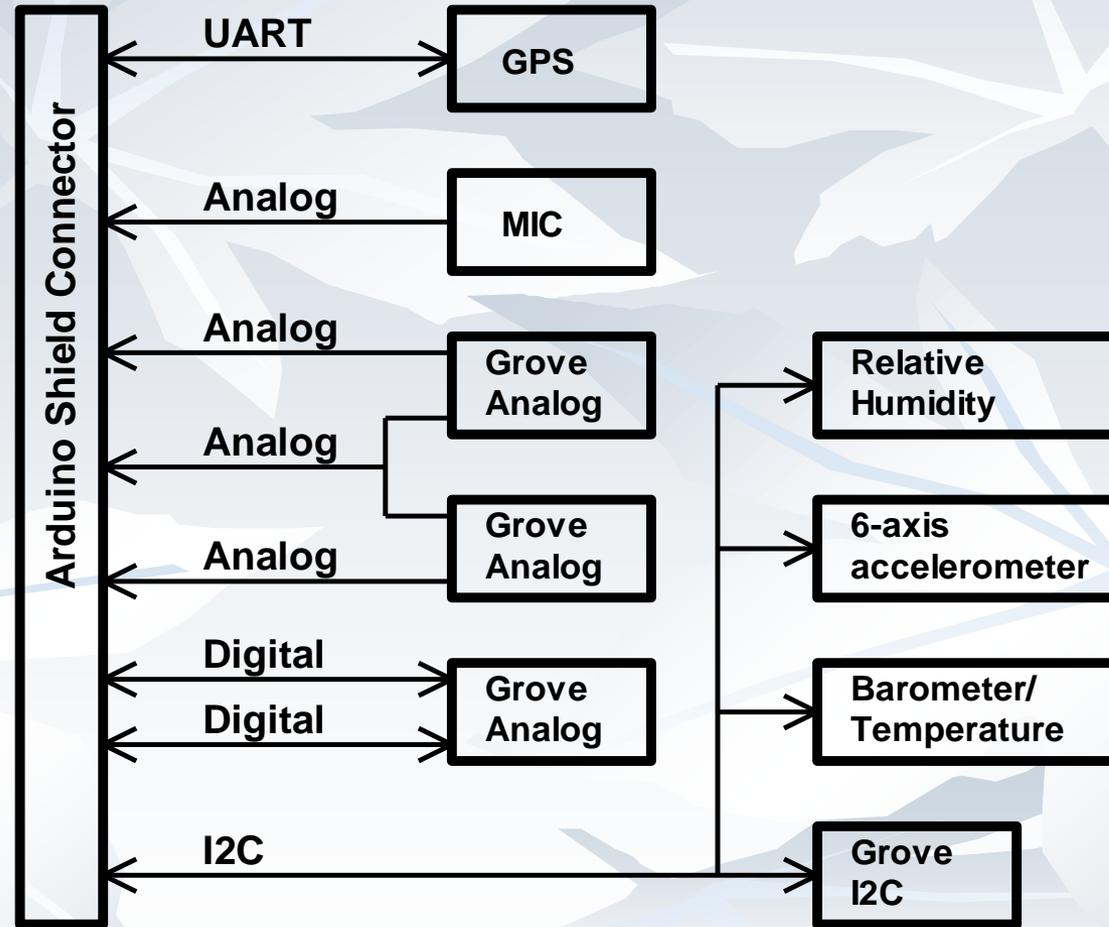


Sensor Shield Board

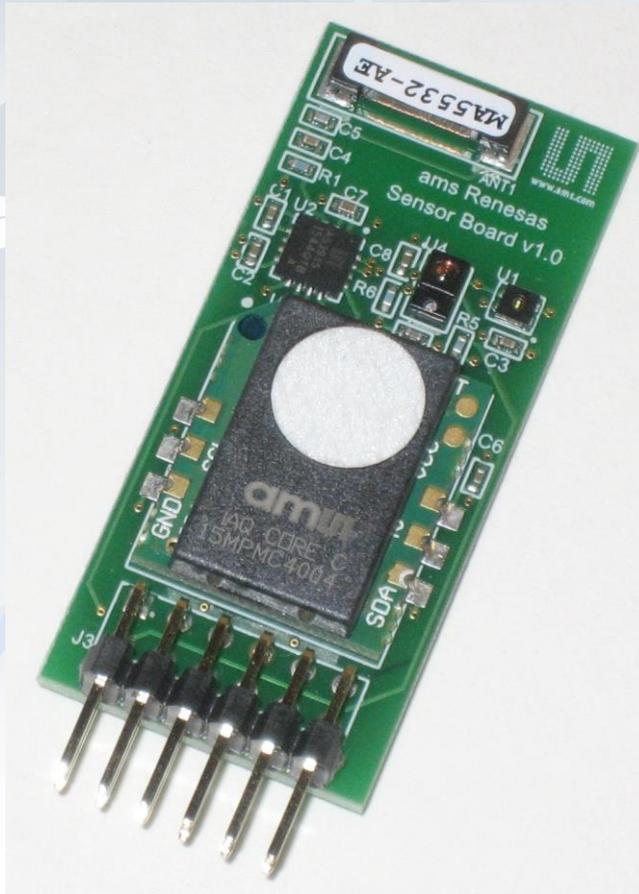


Hardware (device)

Sensor Shield Block Diagram



Hardware (device)

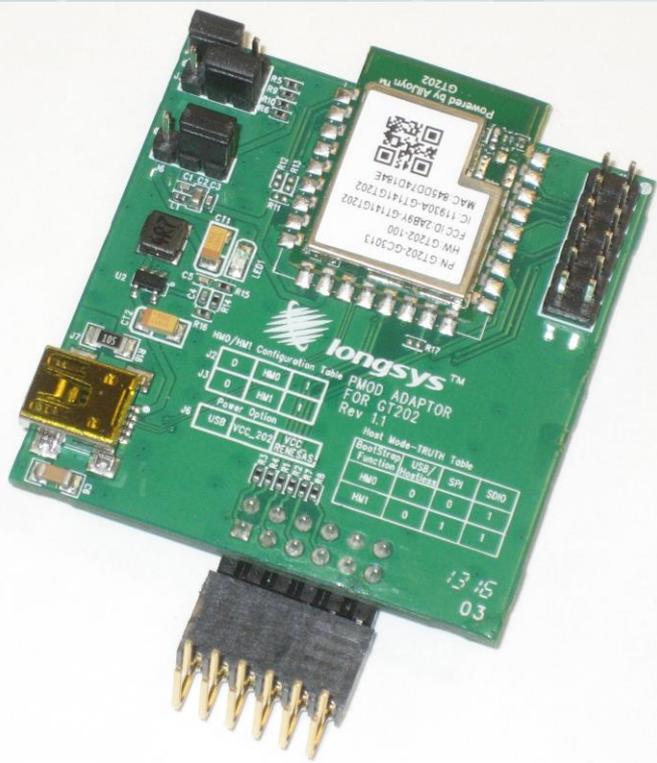


AMS 5-way sensor PMOD

- Proximity/ambient light
- Temperature
- Humidity
- Air quality
- Lightning



Hardware (device)



WiFi PMOD



4G LTE Modem PMOD

UART communications interface over PMOD



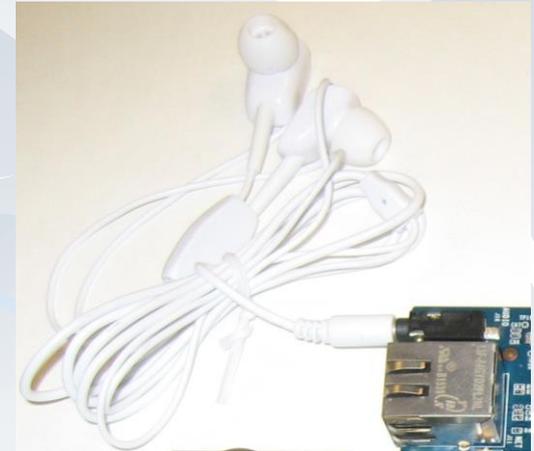
Hardware (device)



USB drive
For S/W and
documentation



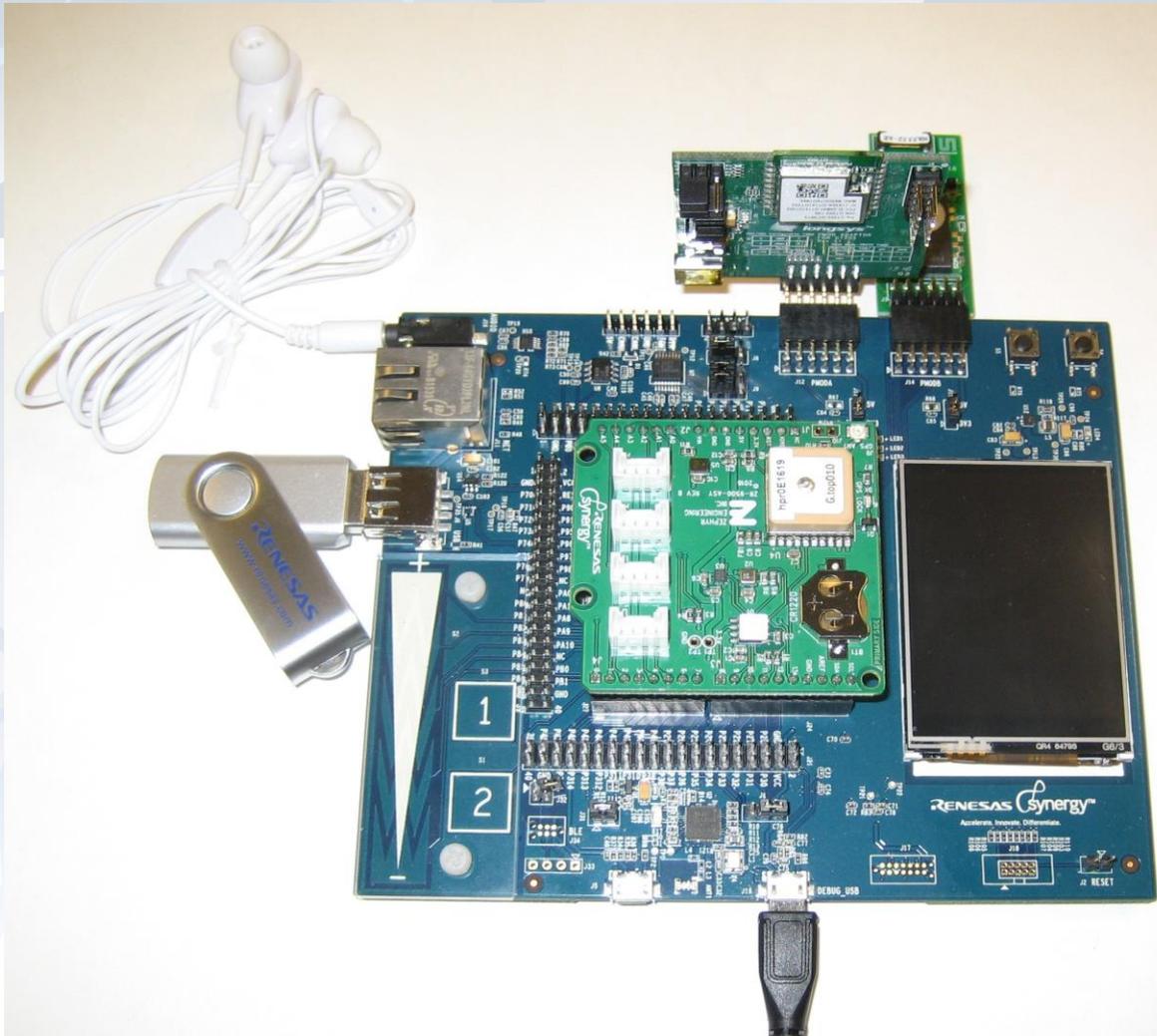
Haptic motor
For physical
alerts



Ear buds
For MP3 audio
and alarms



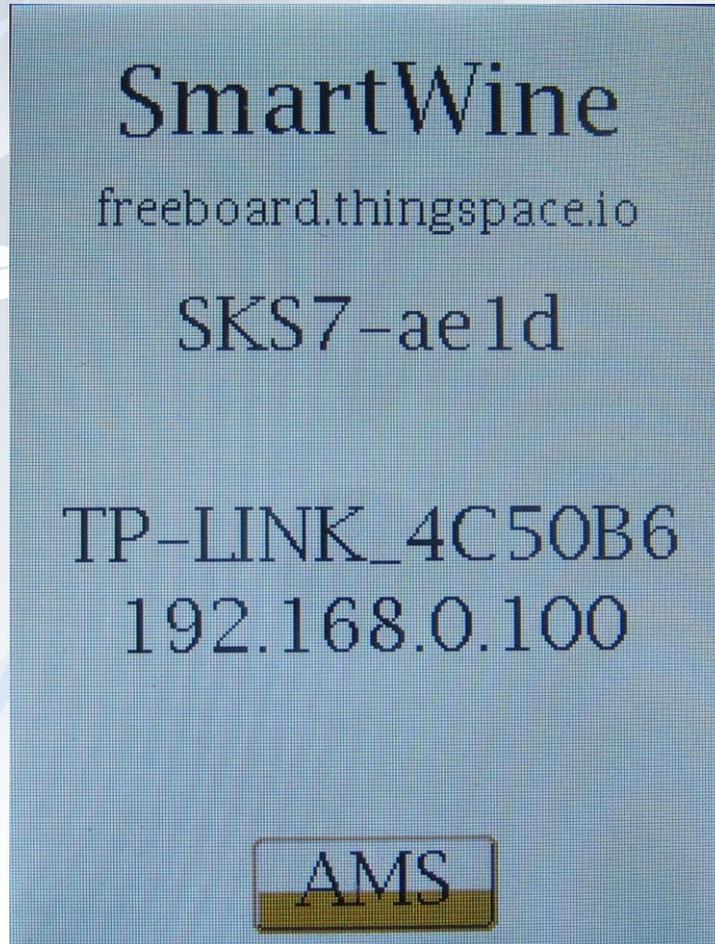
Lab 1: SmartWine



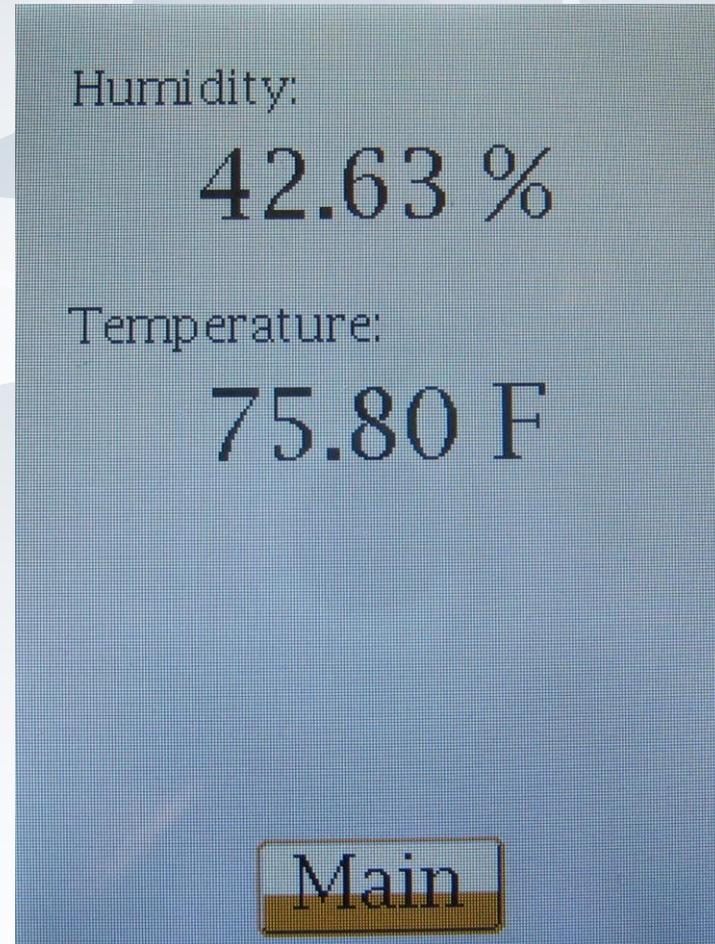
Ready
For Lab 1



Lab 1: SmartWine



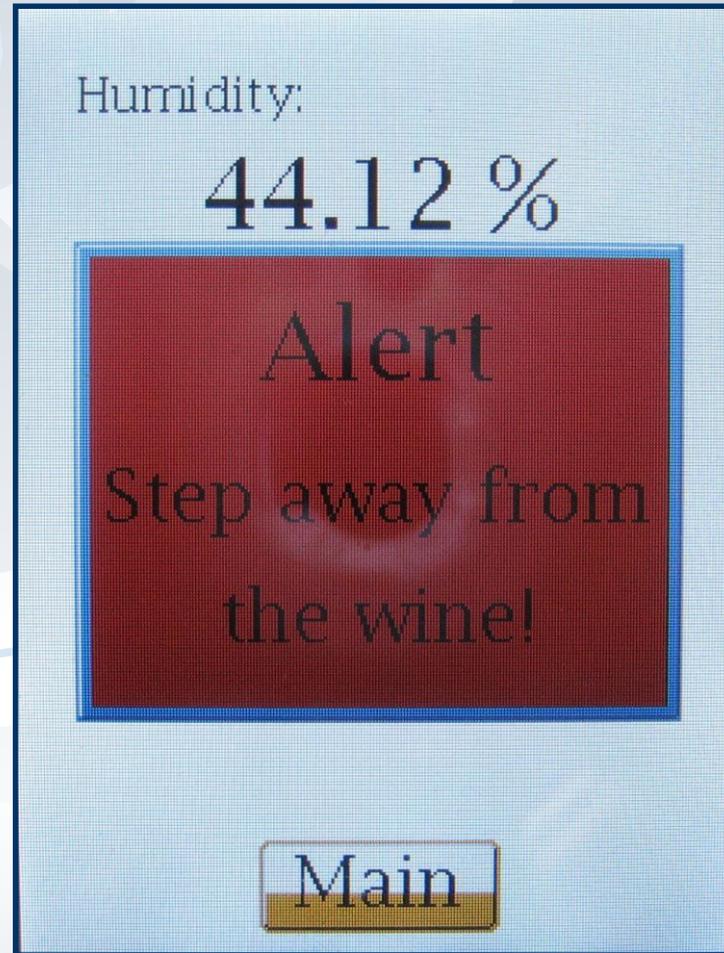
Main Screen



AMS Screen



Lab 1: SmartWine

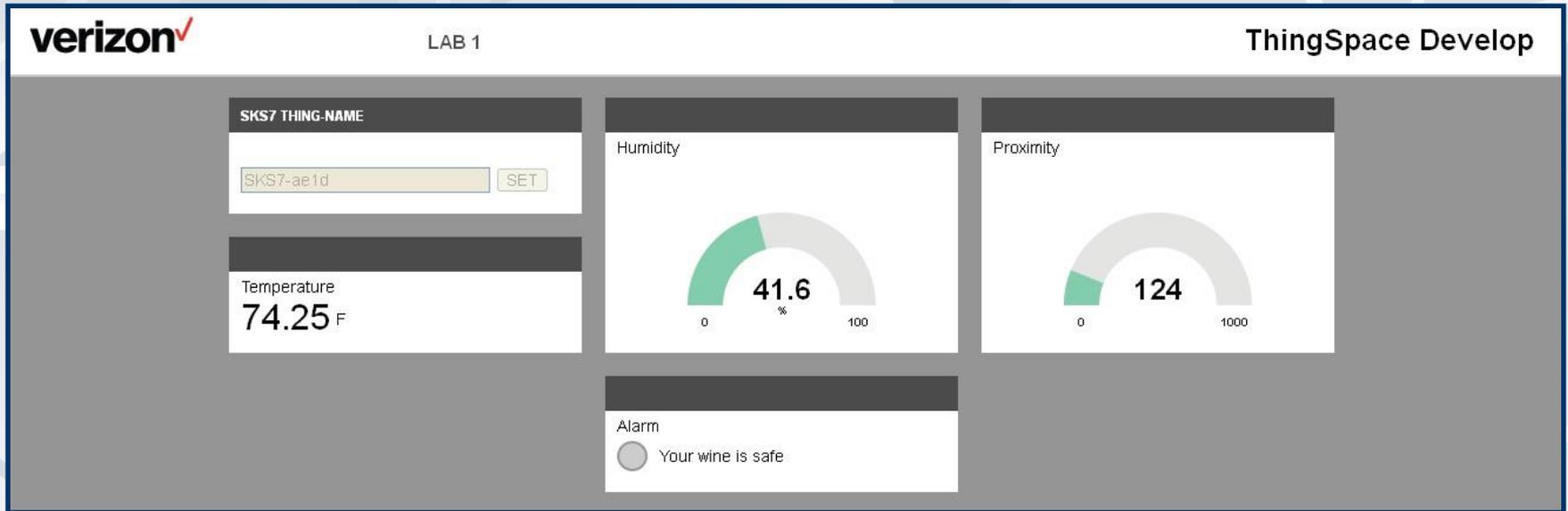


AMS Screen with Alert

©2016 Scotty Cowling WA2DFI



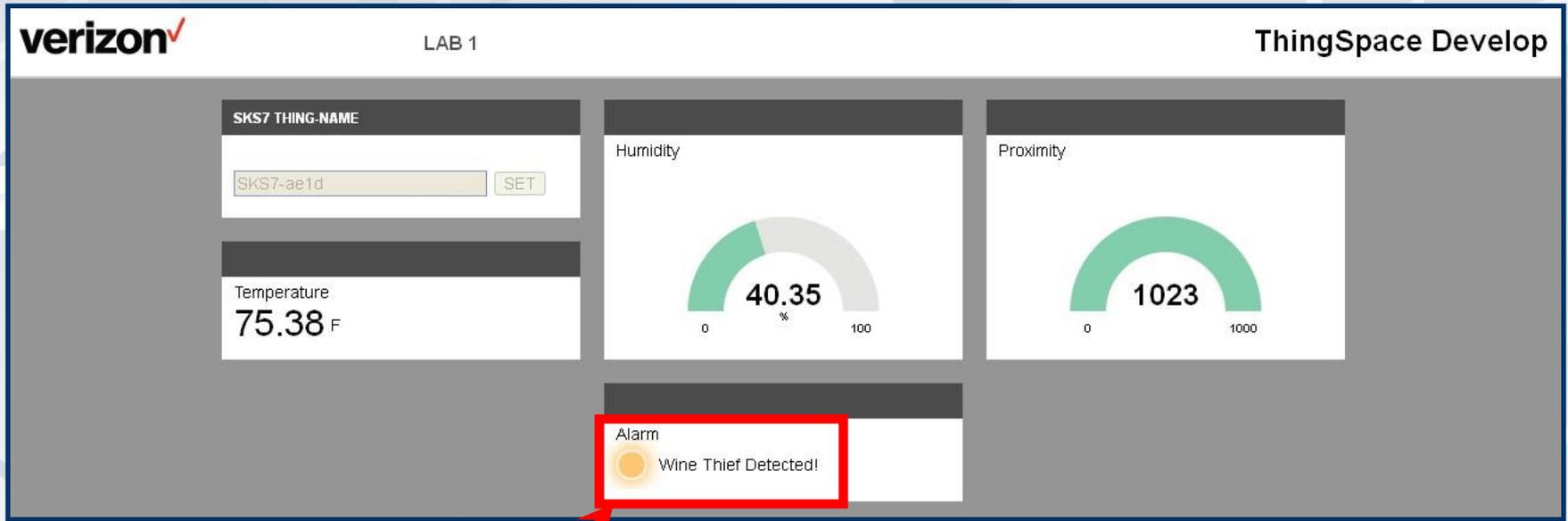
Lab 1: SmartWine



ThingSpace Dashboard in the Cloud



Lab 1: SmartWine



Lookout!

ThingSpace Dashboard in the Cloud



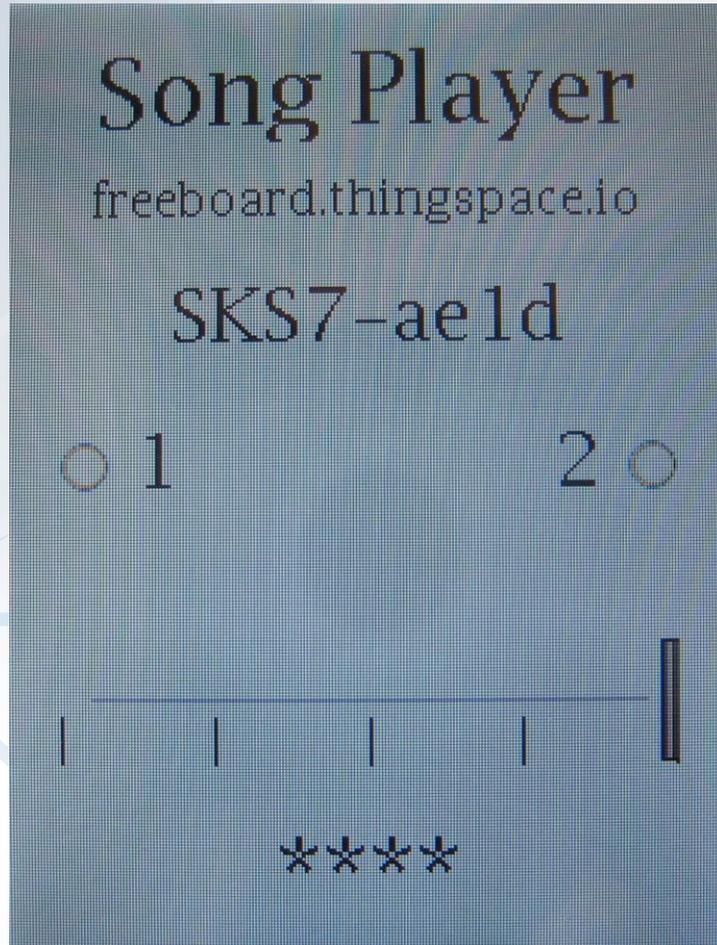
Lab 2: RemoteSongPlayer



Ready
For Lab 2



Lab 2: RemoteSongPlayer



Main Screen



Lab 2: RemoteSongPlayer

verizon LAB 2 ThingSpace Develop

+ ADD PANE
DEVELOPER CONSOLE

Name	Last Updated		
SKS7	3:13:56 PM	↻	🗑️

ADD

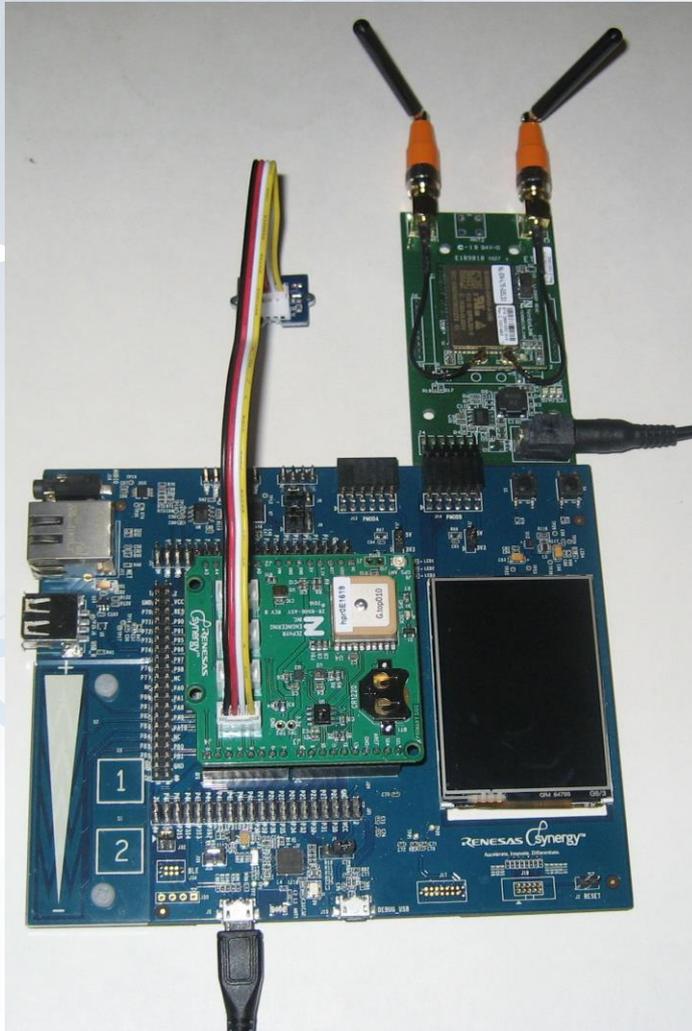
VOLUME
Song Volume
113 dB
0 255

SONG PLAYBACK CONTROL
Song 1 Song 2

Thingspace Dashboard in the Cloud



Labs 3, 4 & 5: Fun With Sensors



Ready
For Labs 3, 4 and 5



Lab 3: Fun With Sensors

Fun w/ Sensors

freeboard.thingspace.io

SKS7-ae1d

Steps: 0

Other Device

Steps: 0

Sensors

Cellular Strength: ****

Main Screen

GPS: 33.39,-111.97

Humidity: 31.51%

Pressure: 28.60 in

Accel: -244,49,906

Mag: -10,12,-124

Mic: 961

Temperature: 82.12F

Main

Sensors Screen



Lab 3: Fun With Sensors

The screenshot displays the Verizon ThingSpace Develop interface. At the top left is the Verizon logo, and at the top right is the text 'ThingSpace Develop'. Below the header, there are two menu items: '+ ADD PANE' and 'DEVELOPER CONSOLE'. The main content area is divided into several sections:

- DATASOURCES:** A table with columns 'Name' and 'Last Updated'. It contains one entry: 'SKS7' with a last updated time of '11:40:08 AM'. There are refresh and delete icons for this entry, and an 'ADD' button below the table.
- LOCATION:** A map view showing a location in Tempe, Arizona. A red pin is placed on the map near 'Arizona Mills'. Other landmarks include 'Tempe Diablo Stadium', 'Raven Golf Club - Phoenix', and 'Cole Park Neighborhood'. The map is powered by Google.
- VOLUME:** A panel titled 'VOLUME' with a sub-label 'Mic Value'. It displays a real-time waveform graph of audio data.
- MAGNETOMETER:** A panel titled 'MAGNETOMETER' showing three data series for X, Y, and Z axes as line graphs.
- HUMIDITY:** A panel titled 'HUMIDITY' showing 'Temperature' at 73.85 °F and 'Humidity' at 37.01 %.
- GPS:** A panel titled 'GPS' showing 'Altitude' at 343.3.
- ACCELEROMETER:** A panel titled 'ACCELEROMETER' showing a real-time waveform graph of acceleration data.
- BAROMETRIC PRESSURE:** A panel titled 'BAROMETRIC PRESSURE' showing 'Pressure' at 28.66 in.

At the bottom of the dashboard, there is a 'freeboard' button on the left, and on the right, there are icons for 'FULLSCREEN', 'SHARE', and 'CLONE', along with the text 'Powered by Bug Labs'.

ThingSpace Dashboard in the Cloud

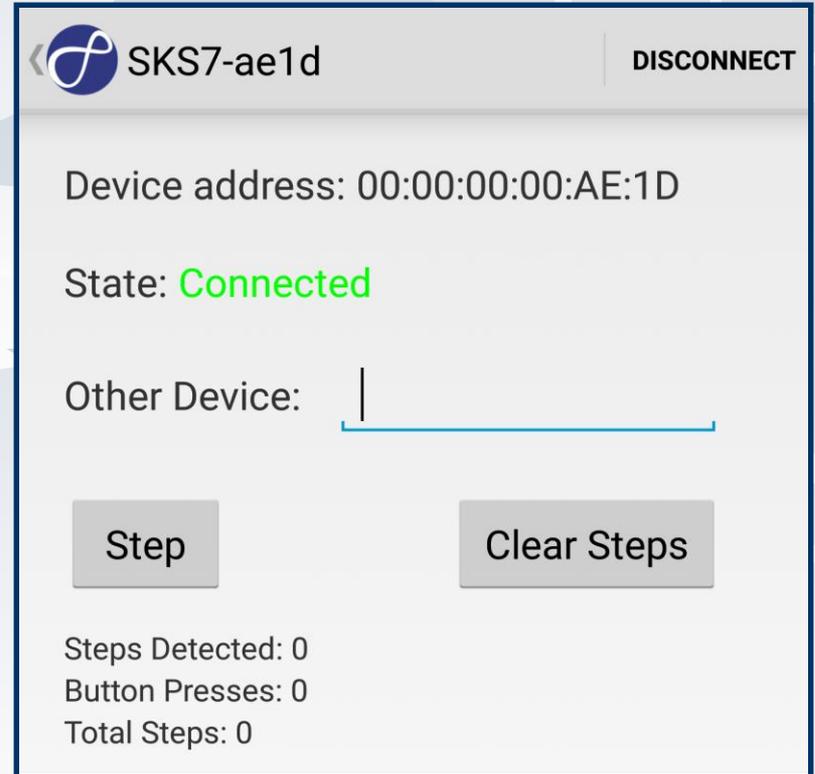
©2016 Scotty Cowling WA2DFI



Lab 4: Fun With Sensors



Main Screen



Phone Screen



Lab 4: Fun With Sensors

verizon LAB 3 ThingSpace Develop

+ ADD PANE
DEVELOPER CONSOLE

DATASOURCES

Name	Last Updated		
SKS7	10:09:54 PM	↻	🗑️

ADD

MY STEPS + 🔧 🗑️

My Step Count
5 Steps

LOCATION + 🔧 🗑️

E Wier Ave
Tempe Diablo Stadium
S River



ThingSpace Dashboard in the Cloud

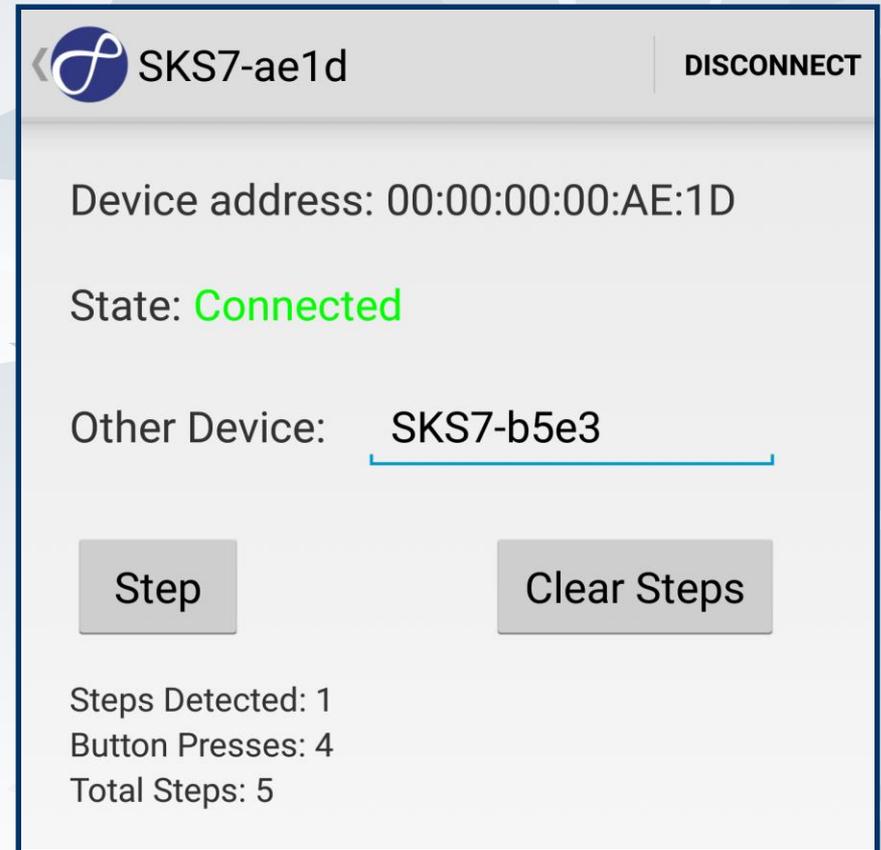
©2016 Scotty Cowling WA2DFI



Lab 5: Fun With Sensors



Main Screen



Phone Screen



Lab 5: Fun With Sensors

The screenshot shows a ThingSpace dashboard with the following components:

- Header:** Verizon logo, LAB 3, ThingSpace Develop
- LOCATION:** A Google Map showing a red location pin. Text: "South Mountain Environmental", "Map data ©2016 Google", "Terms of Use", "Report a map error".
- VOLUME:** "Mic Value" with a line graph showing audio amplitude.
- MAGNETOMETER:** Line graphs for X, Y, and Z axes.
- HUMIDITY:** "Temperature 74.67 °F", "Humidity 35.37 %".
- GPS:** "Altitude 357.8".
- ACCELEROMETER:** Line graphs for Roll, Yaw, and Pitch.
- MY STEPS:** "My Step Count 5 Steps".
- OTHER STEPS:** "Other Step Count 53 Steps".
- BAROMETRIC PRESSURE:** "Pressure 28.6 in".
- Footer:** freeboard, FULLSCREEN, SHARE, CLONE, Powered by Bug Labs.

ThingSpace Dashboard in the Cloud

©2016 Scotty Cowling WA2DFI



Thank You!

Renesas Synergy:

renesas.com/synergyapplicationprojects

BugLabs Freeboard: freeboard.io

Verizon ThingSpace:

thingspace.verizon.com/developer

Arrow Electronics (Seminars): arrow.com

Zephyr Engineering, Inc: zpci.com/renesas

