

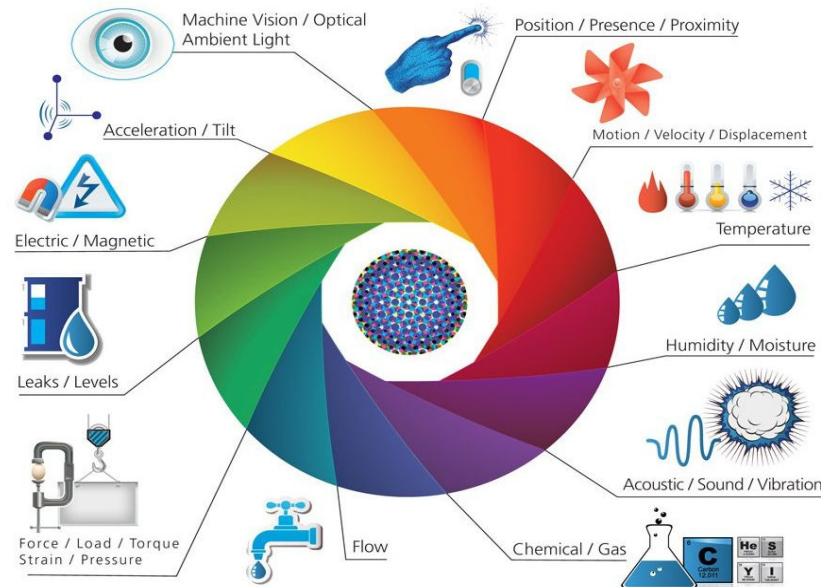


OpenADR and the Internet of Things

Jim Zuber, CTO, QualityLogic, Inc.

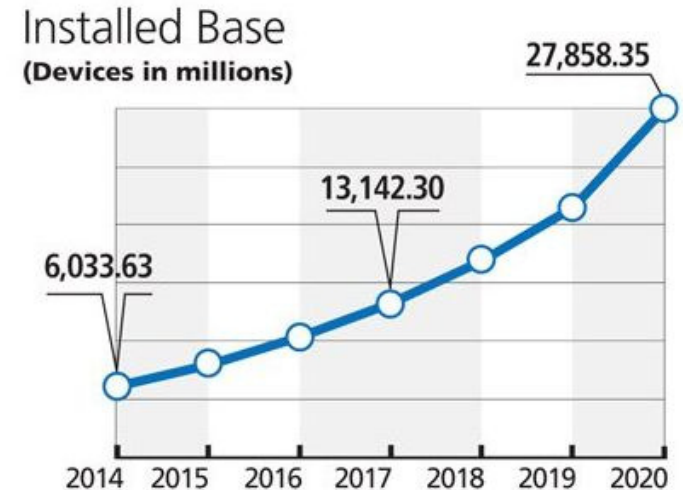
Internet of Things Defined

- Connecting anything with a switch to the internet
- Players
 - Sensors - Provide state change information about the world around us
 - Actuators - Make something happen in response to sensor state changes
 - Rule Engines – Decide what actuators get triggered in response to sensor state changes



Enabling Technologies

- The availability of
 - Small inexpensive sensors and microcontrollers
 - Pervasive wired and wireless connectivity (WiFi, ZigBee, Z-Wave, Bluetooth, etc.)
 - Hubs and gateways that bridge wireless protocols
 - Cloud computing
- ...has resulted in thousands of IoT products that can be...
 - Controlled
 - Monitored
 - Remotely configured
 - Interoperate with each other
 - Automated through simple rules engines



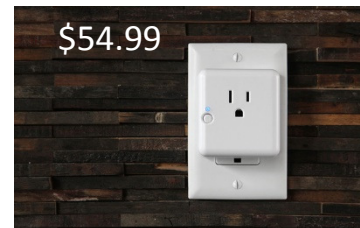
Consumers Will Pay for IoT



SmartThings Hub



SmartThings Motion Sensor



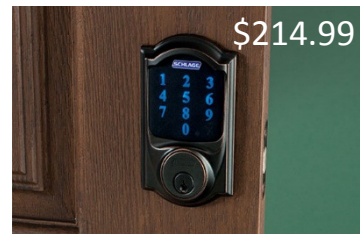
SmartThings Outlet



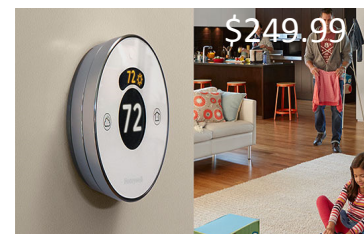
SmartThings SmartSense Temp/Humidity



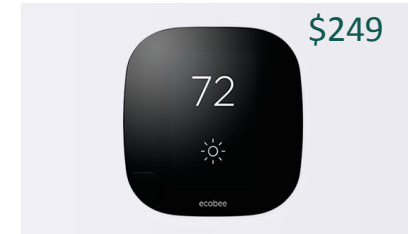
LIFX WI-FI LED Smart Bulb



Schlage Touchscreen Deadbolt

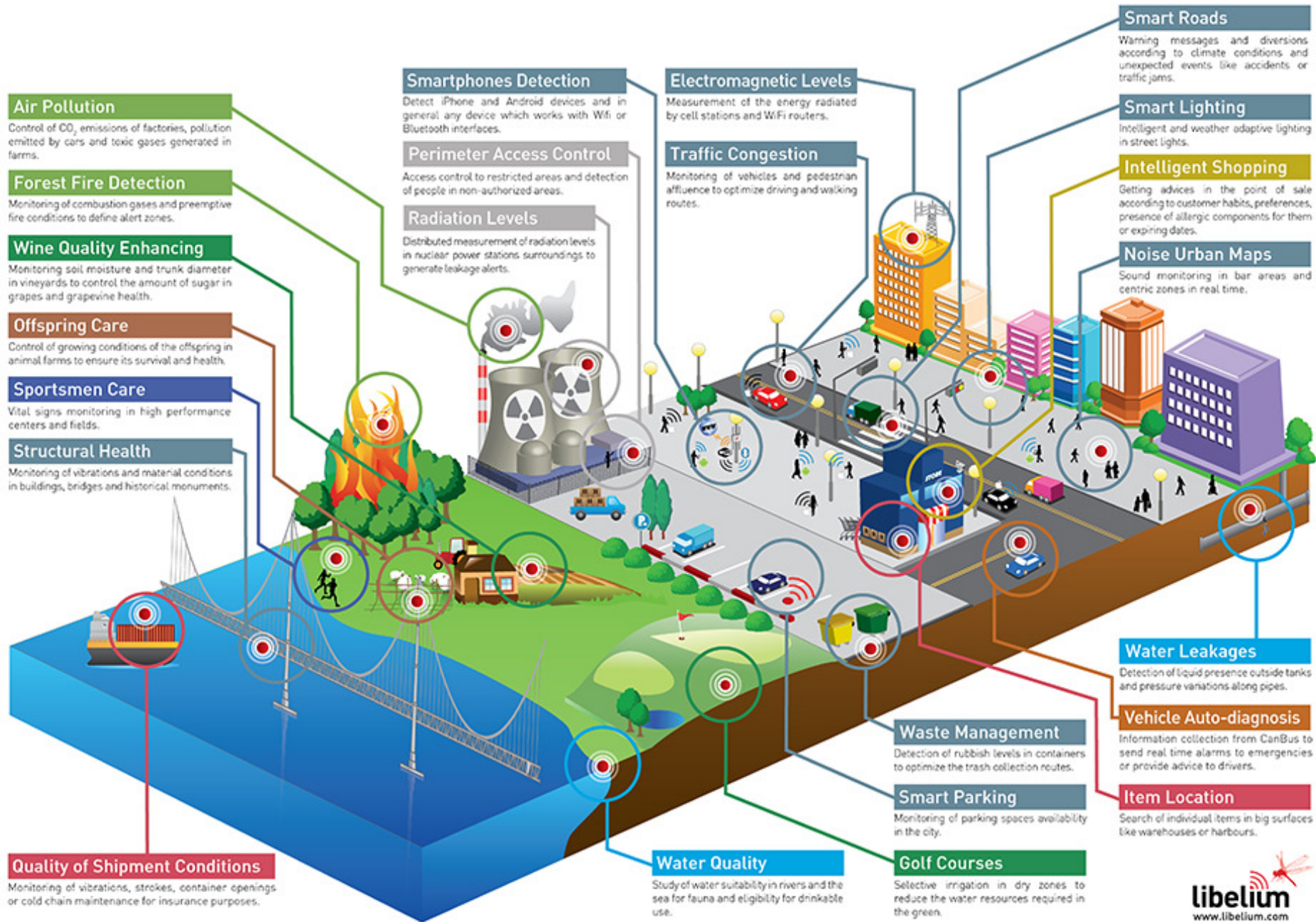


Honeywell Lyric Thermostat



Ecobee3 Thermostat

- \$99 Hub enables complete smart home for under \$1000
- Consumers will invest for multiple benefits – security, remote monitoring and control, comfort
- But not for single purpose DR systems



Demand Response and IoT

- Why is this exciting for the Demand Response (DR) space?
- Traditional DR model: utility/aggregator fund infrastructure to enable DR
- IoT DR opportunity:
 - Thousands of IoT products whose load profile can be remotely controlled
 - Consumers comfortable defining “rules” that control load behavior
 - Commercial, industrial, and city infrastructures leveraging IoT technologies
 - Millions (or billions) of devices that could participate in DR with minimal infrastructure investment

OpenADR Enabling SmartThings Hub

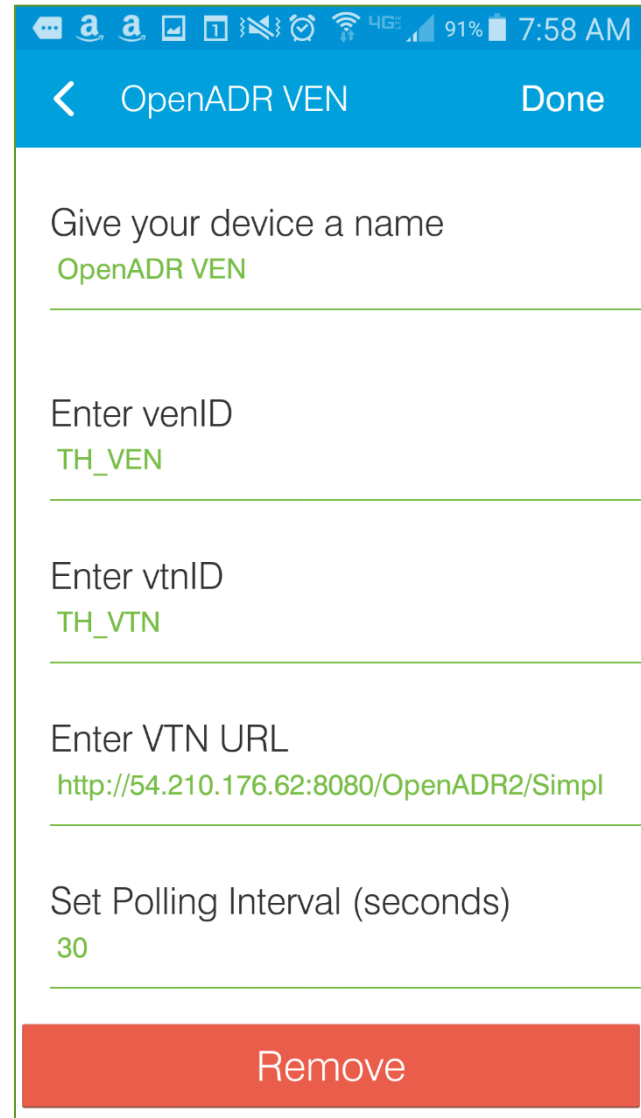
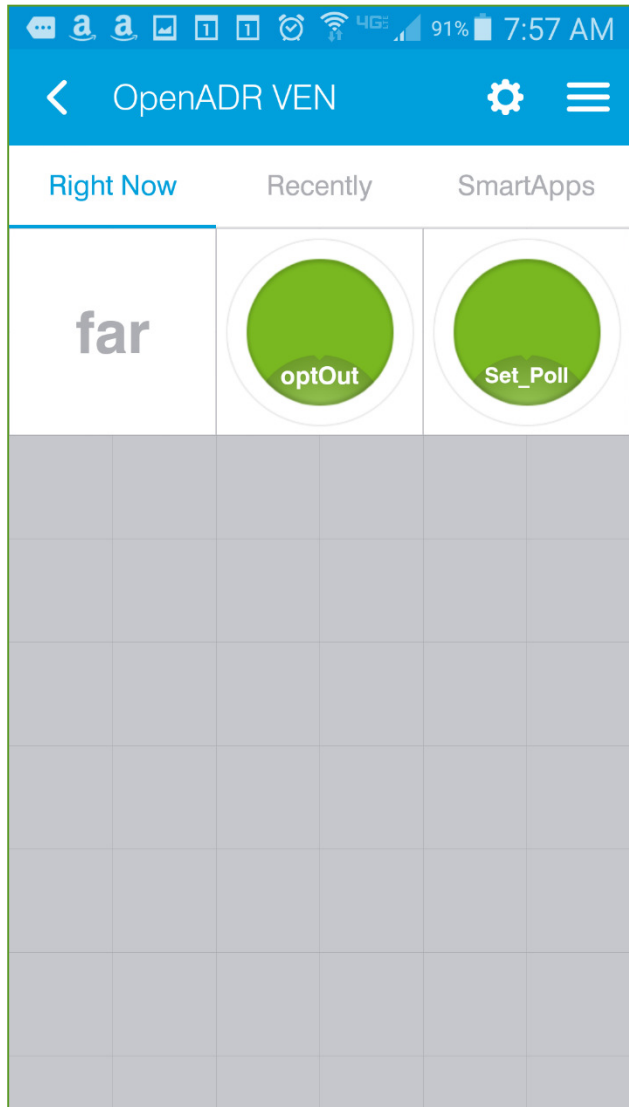
- Determine if the popular SmartThings home control system can be leveraged to support DR
 - Kickstart funded company acquired by Samsung for \$200M in 2014
 - SmartThings technology to be leveraged across Samsung electronic/appliance offerings
 - Data point – SmartThings mobile App downloads 300K +



Technical Approach

- Approach...
 - Write a OpenADR A profile VEN as SmartThings “device handler”
 - Receipt of an OpenADR signal would appear as a sensor state change
 - Use “Rules Engine” SmartApp to define behaviors for normal, moderate, high, and special load shed upon receipt of state change
- Challenges...
 - Extremely constrained programming environment
 - Very limited execution environment (40 second limit)
 - Slightly unstable environment (Polling from Cloud)
 - Arduino fallback – ZigBee ping






SmartThings Project



SmartThings Project

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< ☰

-  **Both Doors Open**
Notifies you when you have left both doors open longer than a specified amount of time. >
-  **NestModePresence**
Set Nest away and present modes based on whether everyone is gone or someone is home. >
-  **OpenADR_Poll**
Poll or refresh VTN periodically. >
-  **Rule**
Rule >
-  **Rule Machine**
Rule Machine >

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Installed Rules, Triggers and Actions [4]

- High Load Shed >
- Moderate Load Shed** 
- Normal Load Shed >
- Special Load Shed >
- Create New Rule... >

Expert Features

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< Moderate Load Shed Done

Name the Rule
Moderate Load Shed

Select Conditions
OpenADR VEN open [FALSE] >

Define Rule
OpenADR VEN open [FALSE] >

Select Actions for True
Dim: Cree Bulb: 40
Fidure Thermostat:
Mode: heat
Heat to 68 >

Select Actions for False

SmartThings Project

- A few weeks of effort to code an A profile VEN
- A few minutes to set up rules and have my home responding to OpenADR events
- Enabling consumer IoT devices with load profiles to respond to OpenADR appears very doable technically
- However, lots of business and logistics issues to address to implement



IoT - Room for Improvement

- Many IoT devices are dependent a cloud computing infrastructure. What happens when the network goes down?
- The process of discovering and pairing devices is painful.
- Consumer lot devices are finicky, not quite ready for prime time, but if you're willing to tinker, they are great
- Having a common nomenclature for devices types, sensor states, and control actions is needed.