



Overview of the Intel® Internet of Things and the Commercial IoT Developer Kit

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I would make:
I would make:

A Season of Sherlock BBC ← But, the
That has MORE than 3 episodes are 1.5 hrs.
(seriously Moffat) standard 20 min ing

What is the Internet of Things?





The idea of the Internet of Things is that instead of having a small number of powerful computing devices in your life, you have a large number of low energy, ubiquitous computing devices.

The Internet of Things is ...

50B
DEVICES¹

212B
Sensors

44
ZETABYTES²

85%
UNCONNECTED⁴



Mobile



Industrial



Home



Network



DC/Cloud

COST OF
SENSORS
PAST 10
YEARS¹

2X

COST OF
BANDWIDTH
PAST 10
YEARS²

40X

COST OF
PROCESSING
PAST 10
YEARS³

60X

NEED FOR IOT

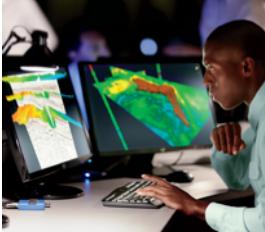
The Internet of Things (IoT) is fueling innovation across a range of industries to optimize processes and increase efficiency.



Greater efficiency for HVAC systems, which account for 41% of U.S. building energy use.¹

SMART BUILDING

Energy use monitoring; sensors in heaters and chillers to find inefficiencies



IoT can optimize energy grids, which lose ~6% during transmission and distribution.³

ENERGY

Environmental data logging, substation monitoring, grid efficiencies



Manufacturers using IoT report 82% increased efficiency and 49% fewer defects.⁴

INDUSTRIAL & MANUFACTURING

Assembly-line equipment reporting, inventory management; automation



Enhanced driver coaching can save nearly 7% on fuel costs.⁵

TRANSPORTATION

Fleet management, freight tracking, urban congestion management



Supermarket cost-to-sales ratios can be reduced 2% by automatic checkout.²

RETAIL

Point of sale, vending machines, supply chain

1. [Research & Development Roadmap for Emerging HVAC Technologies](#). U.S. Department of Energy (October 2014).

2. [The Internet of Things Is Now, Connecting the Real Economy](#). Morgan Stanley (April 3, 2014).

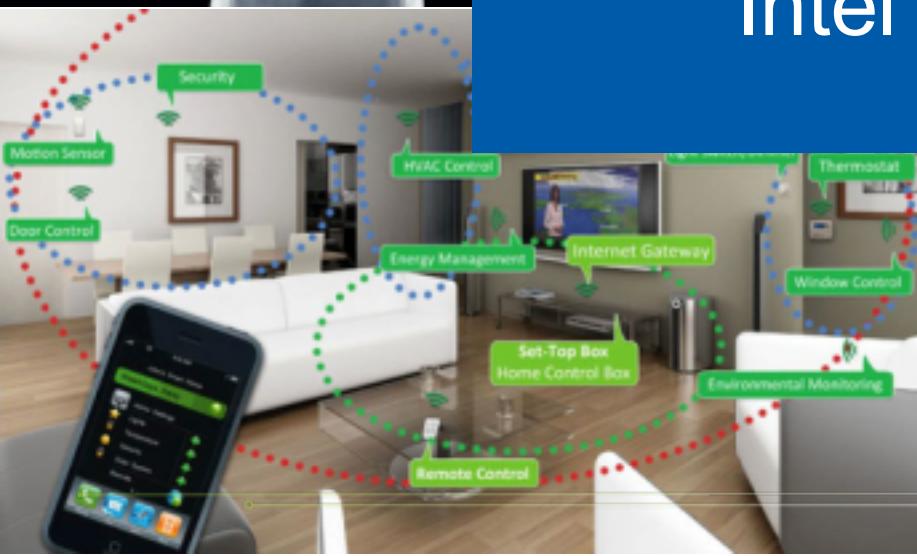
3. [How much electricity is lost in transmission and distribution in the United States?](#) U.S. Energy Information Administration (April 6, 2016).

4. ["How Manufacturers Use IoT for Operational Efficiencies."](#) Industry Week (October 21, 2015).

5. [Tech Today Video Series Episode 3: Vnomic](#). Intel (March 4, 2014).



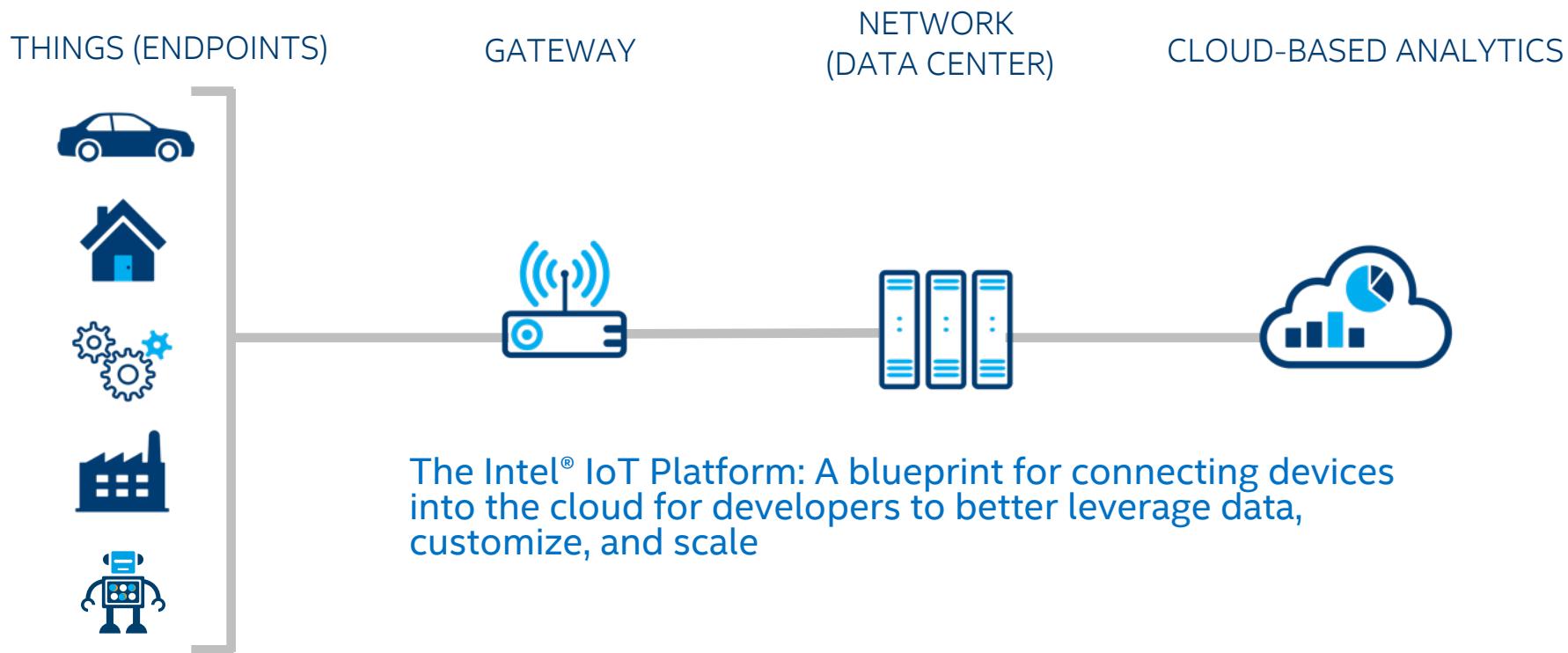
Intel IoT



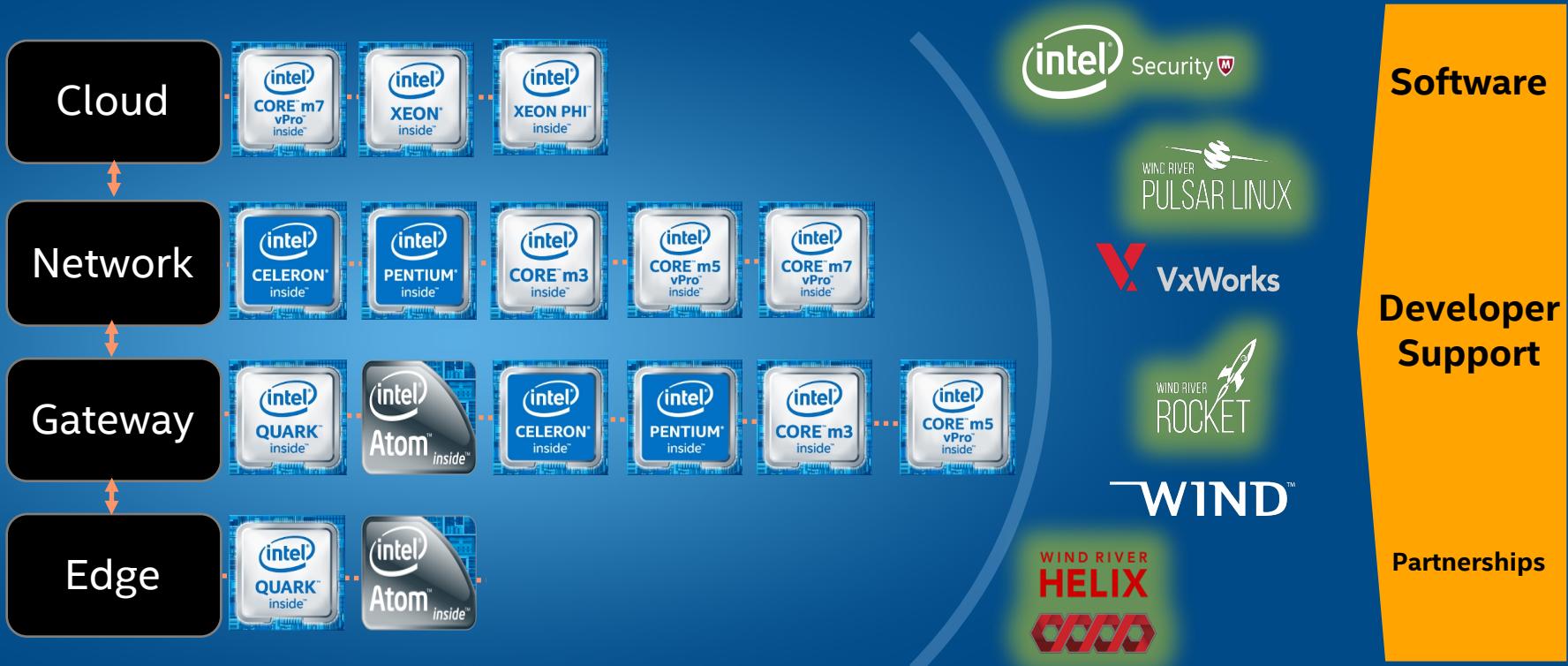
intel
Software

INTEL® ARCHITECTURE POWERS

Endpoints, Gateways, Networks, and Cloud



THE MOST COMPREHENSIVE EDGE TO CLOUD SILICON, SOFTWARE AND SUPPORT PERIOD



More than **200 IoT** discrete ingredients from automotive to industrial to consumer

INTEL® IOT DEVELOPER KIT

- Supports Intel® IoT Gateways, Intel® Edison and the new Intel® Joule
- Middleware libraries for I/O and sensors or actuators
- IDEs and tools to create, run, debug, and optimize IoT solutions
 - Arduino*, C/C++, JavaScript*, Python*, and Java* programming language support
 - Advanced power efficiency/performance optimization tools
 - Examples with Wind River* Helix* Cloud
- Deep hardware and software insights to speed development, testing, and optimization
- IoT cloud and edge analytics for data collection, visualization, and analytics

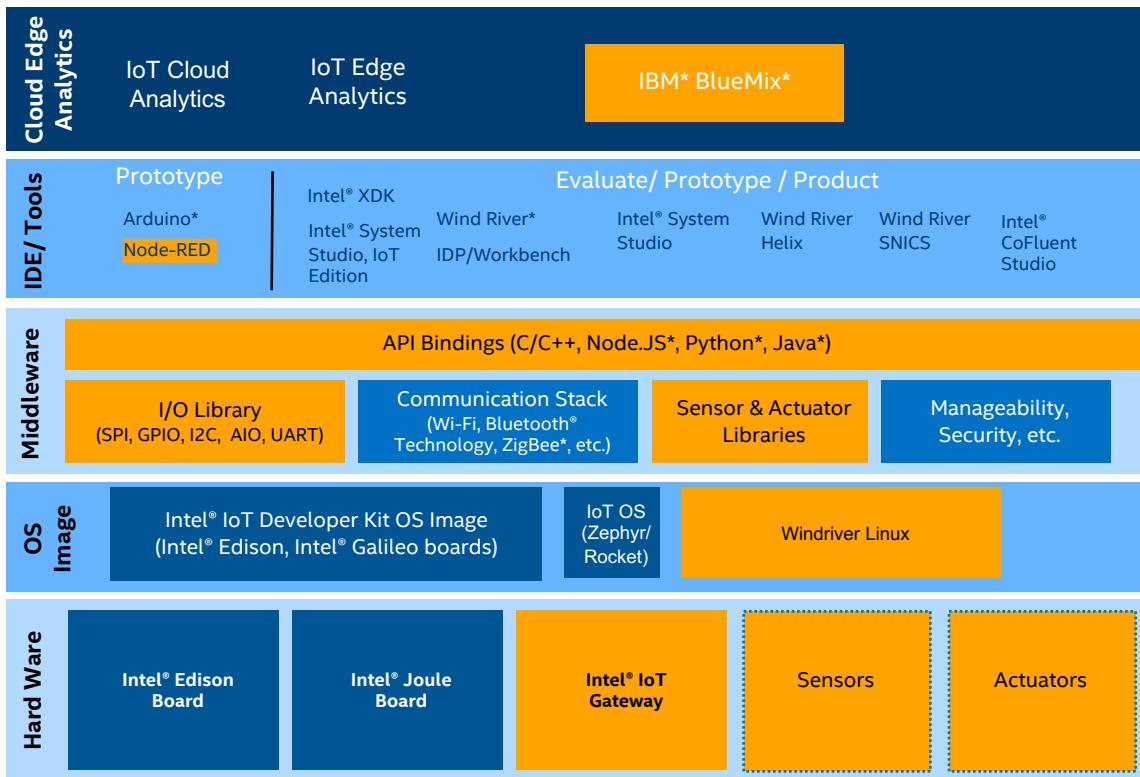
Cloud Edge Analytics	IoT Cloud Analytics	IoT Edge Analytics	IBM* BlueMix*				
IDE/ Tools	Prototype Arduino* Node-RED	Intel® XDK Intel® System Studio, IoT Edition	Wind River* IDP/Workbench	Intel® System Studio	Wind River Helix	Wind River SNICS	Intel® CoFluent Studio
Middleware	Evaluate/ Prototype / Product						
Middleware	API Bindings (C/C++, Node.JS*, Python*, Java*)		I/O Library (SPI, GPIO, I2C, AIO, UART)		Communication Stack (Wi-Fi, Bluetooth® Technology, ZigBee*, etc.)		Sensor & Actuator Libraries
OS Image	Intel® IoT Developer Kit OS Image (Intel® Edison, Intel® Galileo boards)		IoT OS (Zephyr/ Rocket)		Windriver Linux		
Hard Ware	Intel® Edison Board	Intel® Joule Board	Intel® IoT Gateway	Sensors	Actuators		

More details: <https://software.intel.com/en-us/iot/hardware/devkit>



INTEL® IOT DEVELOPER KIT

- Intel® NUC Gateway
- Node-RED as a prototyping tool
- Intel® XDK IoT for JavaScript programming & Gateway configuration
- MRAA/UPM libraries for sensor interface
- IBM* BlueMix* connection for cloud analytics



More details: <https://software.intel.com/en-us/iot/hardware/devkit>

What are we going to learn today?

- Overview of Intel IoT
- Overview of Intel Commercial Developer Kit
- Basic IoT Gateway Operation
- Gather Sensor Data and Send to Watson IoT with Node-RED
- Configure Gateway Security Features

Getting to Know the Commercial Dev Kit

Intel NUC + Arduino 101 + Grove Kit

What's in the Kit?



- Intel NUC running Windriver Linux
- Grove Starter Kit Plus
- Arduino/Genuino 101
(Sold Separately)



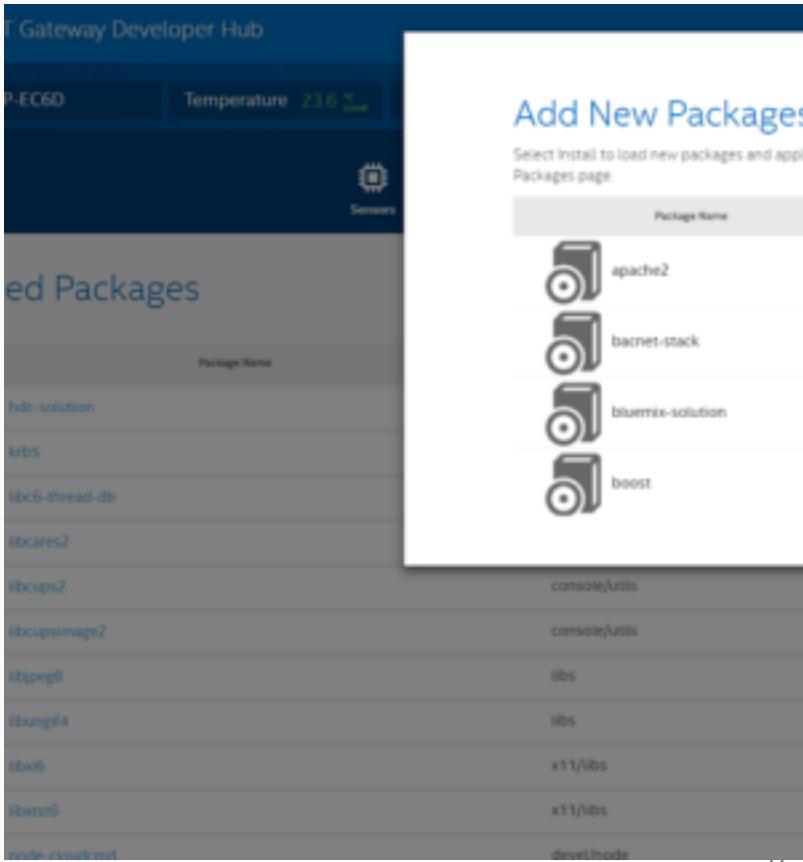
- Runs on Windriver Linux
- Includes Dev Hub, Node-RED, App Cloud, and connectivity to the 01.org repo for additional packages
- Node-RED is the easiest way to get started
- Python, Node.js, Java, and a full C/C++ toolchain are available as well
- libmraa can be used to interface with sensors connected to the Arduino 101



Key Features in Windriver Linux

Developer Hub, Node-RED, Security Features, and more

- Manage Sensors (Node-RED)
- Visualize Data with Charts
- Manage Packages
- Administration
 - Factory reset, create USB images, upgrade, file manager, console, etc.
- Documentation
 - Walk through getting started use cases
- Login: root/root



Hardware	OS and Applications	Data
Resiliency (Intel® SoC HW root of trust and Grub-IMA)	Resiliency (Intel SoC HW root of trust and Grub-IMA)	Data protection (at rest and securing network comms) and resiliency (firewall)
Secure Boot What you intend to have booted is what's being booted	McAfee* Embedded Control or Linux* IMA** Provides system integrity and change control, that is whitelisting	DM-Crypt SW stack to enable data at rest protection
Discrete TPM*** Locking and storing private materials inside the trusted platform module	GRSecurity Allow programs to execute as least privilege policy	Open SSL and IPSec VPN Create private tunnels to raise assurance of the target destination
	Signed RPM Packages Intel® IoT Gateway confirms signature before it applies RPM system	IPTables Linux firewall and network routing software

*Protecting the firmware with security rooted in the HW. The ODM must enable these features in order to have the OEM realize the benefits

**McAfee Embedded Control includes McAfee whitelisting. Linux IMA is an alternative for countries where McAfee Embedded Control may be unavailable.

*** Note that Discrete TPM is not supported in PRC. DK100 & 300 are the only Intel-branded dev kits that support TPM.

Multiple Language Support



- JavaScript – XDK or AppCloud (Cloud9)
- Visual Programming – Node-RED
- C++ - Intel System Studio
- Python Runtime

The screenshot shows the Intel XDK IoT Edition interface. The top bar displays "PROJECTS access_control" and "DEVELOP". The main area is a code editor for "index.js" with the following content:

```
File Edit Find View Navigate Help index.js

47 // 
48 // 
49 var datastore = require("./datastore");
50 var mqtt = require("./mqtt");
51
52 // Colors used for the RGB LCD display
53 var COLORS = {
54   blue: [0, 0, 255],
55   red: [255, 0, 0],
56   white: [255, 255, 255]
57 }
58
59 var TIMEOUT = 30 * 1000;
60
61 var CODE = config.CODE || "1234";
62
63 var VALIDATED = false,
64     EXPECTING_CODE = false,
65     ALARM_IN_PROGRESS = false;
66
67 // Initialize the hardware devices
68 var screen = new (require("jsupm_i2clcd").Jhd1313m1)(6, 0x3E, 0x62),
69     motion = new (require("jsupm_bmp0801").BMP0801)(4);
70
71 // Store record in the remote datastore and/or mqtt server
72 // when access control event has occurred
73 function log(event) {
74   var msg = new Date().toISOString() + " " + event;
75   console.log(msg);
76 }
```

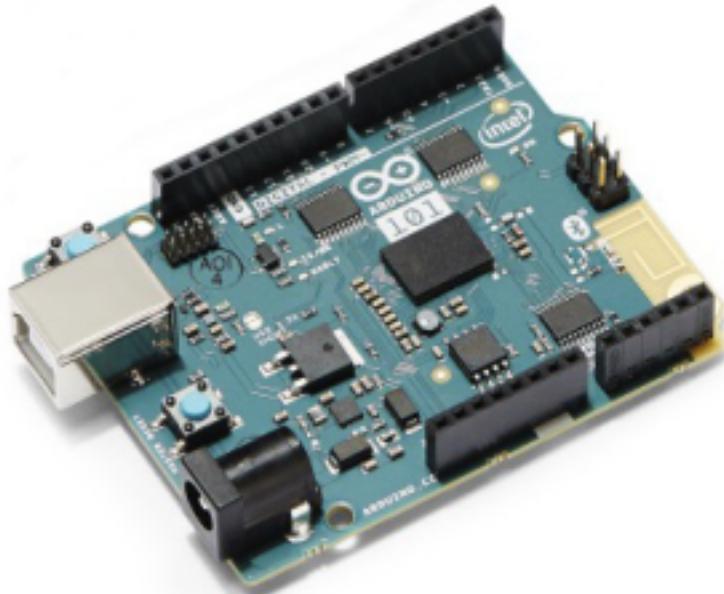
The left sidebar shows the project structure with files like jshintrc, config.json, datastore.js, icon.png, index.html, index.js, LICENSES.md, mqtt.js, package.json, README.md, and xdk-publish-meta-data.json. Below the code editor is a "SENSOR LIBRARIES" section with "Open Sensor Library Explorer" and "Sensor Library Bookmarks". At the bottom, there are tabs for "IoT Device: - Select a Device -", "Intel XDK IoT", "SSH Terminal", and "Serial Terminal".

Sensor Kit: Starter Pack

- Grove Base Shield v2
- Buzzer
- Button
- LED Socket
- Sound Sensor
- Rotary Angle Sensor
- Touch Sensor
- 3 Axis Digital Accelerometer
- Light Sensor
- Temperature Sensor
- Grove - Stepper Motor and Driver
- Red, Green and Blue LEDs
- Grove - LCD RGB Backlight



- Connects to the gateway over USB
- Powered by Intel Curie
- I/O abstracted using libmraa
 - Digital in/out
 - Analog in
 - PWM out
 - I2C



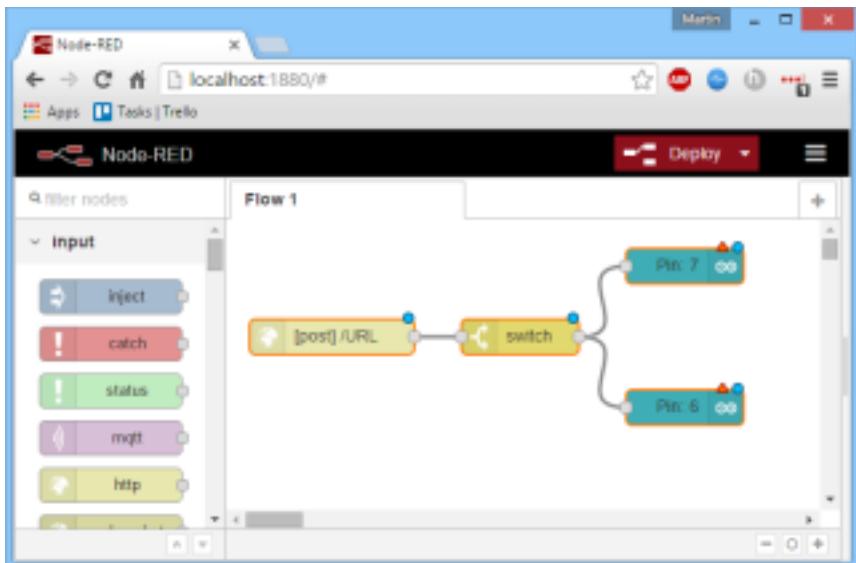
Using Node-RED

Overview and example

What is Node-RED?

Visual Programming Language built on top of the Node.js runtime

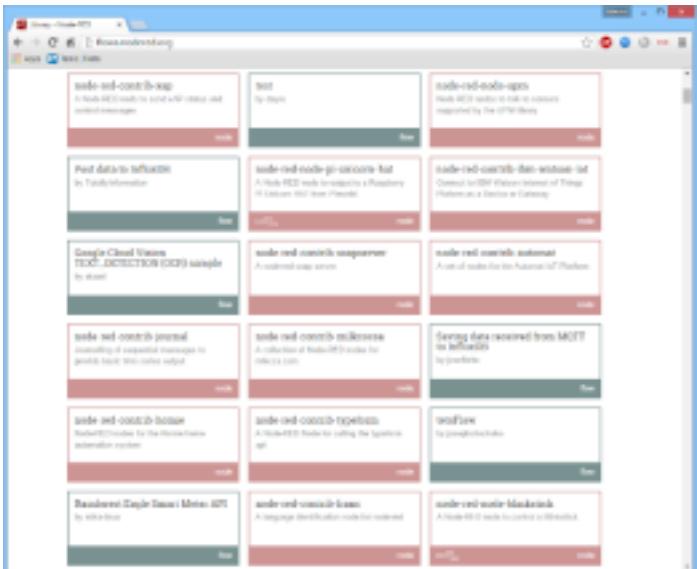
- Does not require programming language background
- Runs in browser
- Excellent tool for rapid prototyping / proof of concepts
- Easy to install and use
- Easy to share projects



Node-RED Nodes



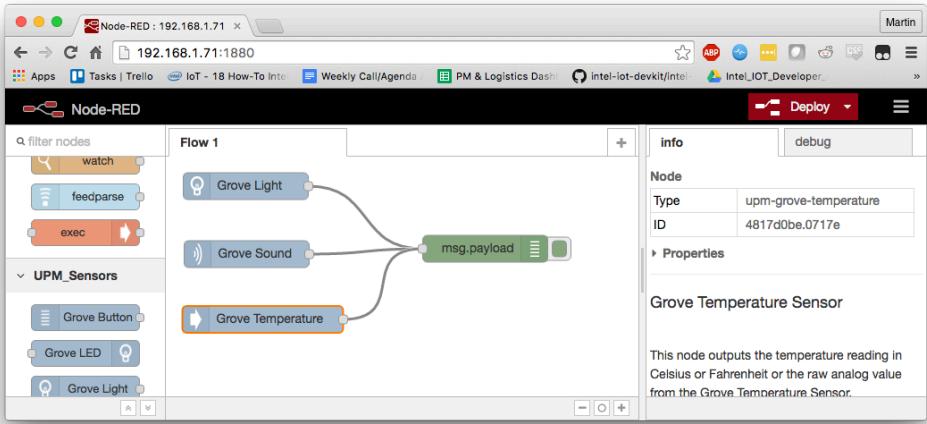
- Nodes are the building blocks of a Node-RED which are connected to create a “flow”.
- Standard nodes include: mqtt, http requests, web sockets, etc.
- Easily install new nodes from a huge node library.
- Create custom nodes with some JavaScript and html knowledge



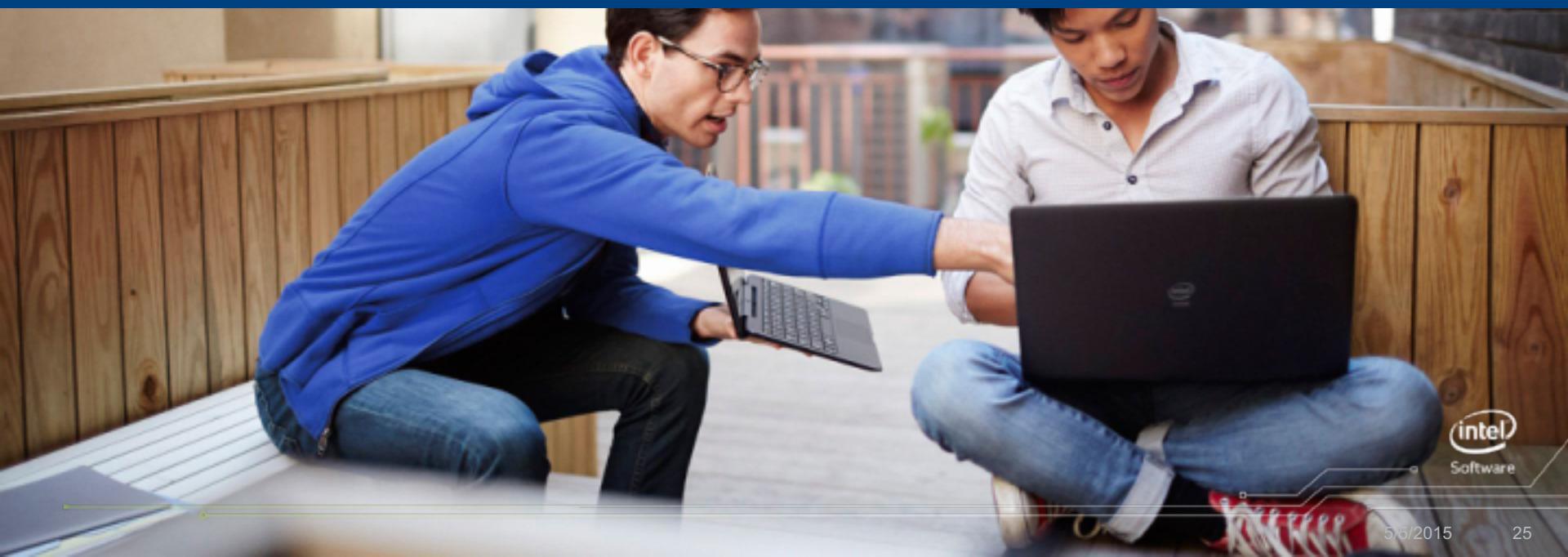
Read Sensors with Node-RED



- Pull in Sensor Nodes you wish to use
- Double click the node to configure
- Select an Analog Port
- Plug in Sensor from kit into the Port you specified
- Wire the outputs to the “debug” node under “Outputs”
- Click Deploy
- Open the debug tab to view sensor data



Find support and more info: software.intel.com/iot



Lets Get Started!



<http://bit.ly/intel-ibm-workshop>



Software

Intel® Software — The Glue That Binds it All Together.



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Software