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

Priyanka Bagade
Intel IoT Developer Evangelist

http://bit.l

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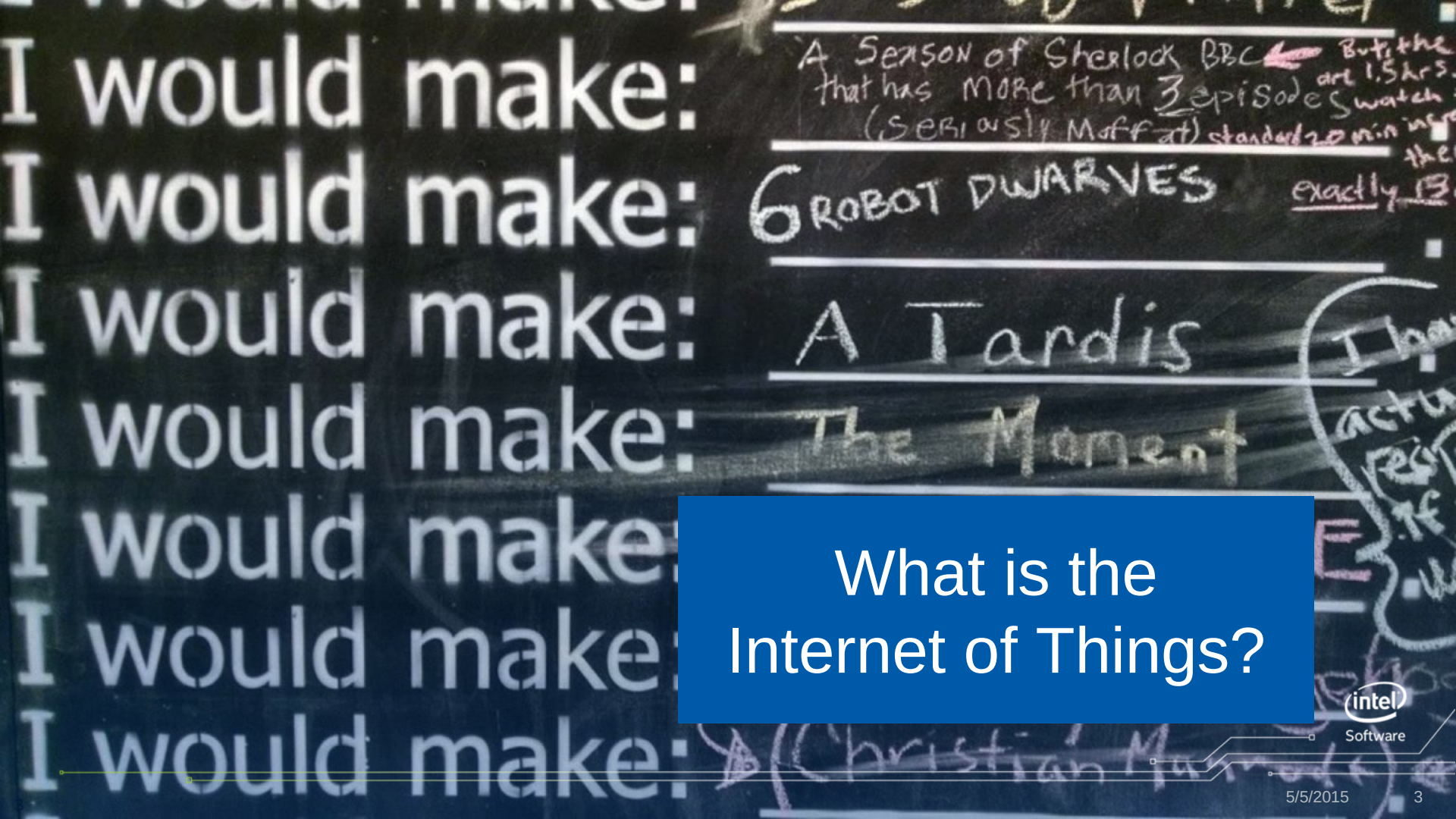
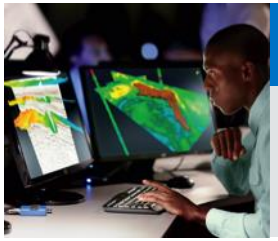


What is the Internet of Things?

NEED FOR IOT

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



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

ENERGY

Environmental data logging, substation monitoring, grid efficiencies

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

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

INDUSTRIAL & MANUFACTURING

Assembly-line equipment reporting, inventory management; automation

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

RETAIL

Point of sale, vending machines, supply chain

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

TRANSPORTATION

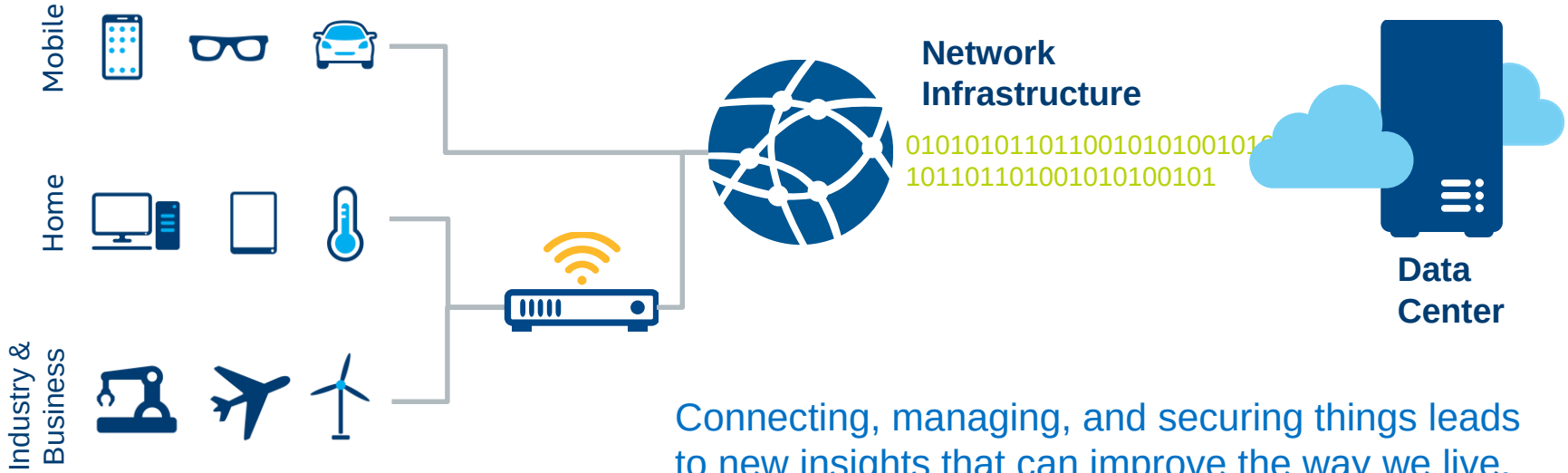
Fleet management, freight tracking, urban congestion management

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: Vnomics. Intel (March 4, 2014).

IOT OVERVIEW

50B devices connecting to the Internet by **2020**[1]

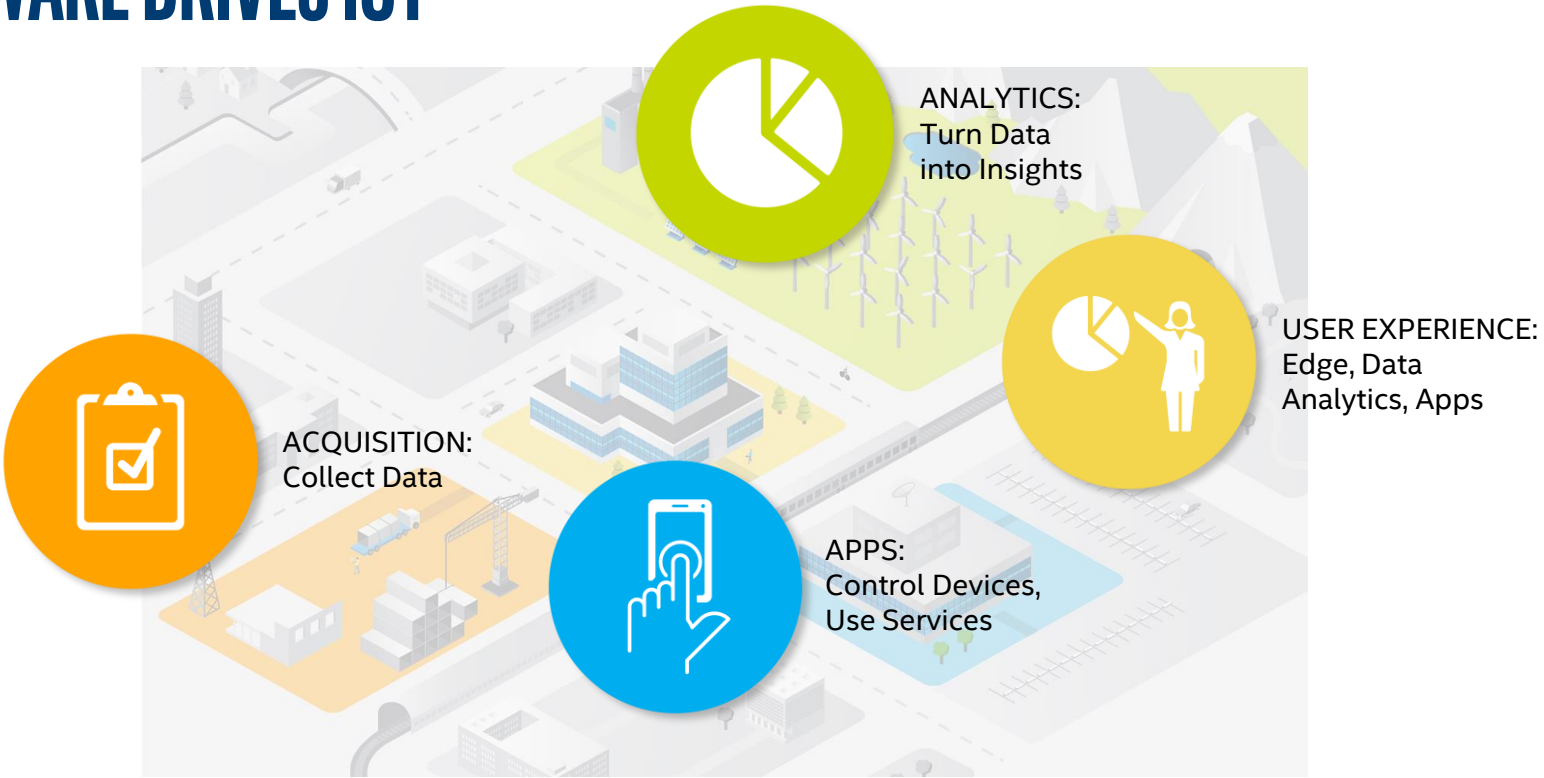
Resulting in 400% more cloud traffic.[2]



Connecting, managing, and securing things leads to new insights that can improve the way we live.

1. *The Internet of Things in Logistics*. DHL Trend Research and Cisco (2015).
2. Cloud traffic will increase 400% by 2019. *IDC FutureScape: Worldwide Internet of Things 2015 Predictions* (2014).

SOFTWARE DRIVES IOT



Software developers deliver value at each step of the solution.

Intel IoT


Security
Motion Sensor
Door Control
HVAC Control
Thermostat
Energy Management
Internet Gateway
Window Control
Set-Top Box
Home Control Box
Environmental Monitoring
Remote Control


intel
Software

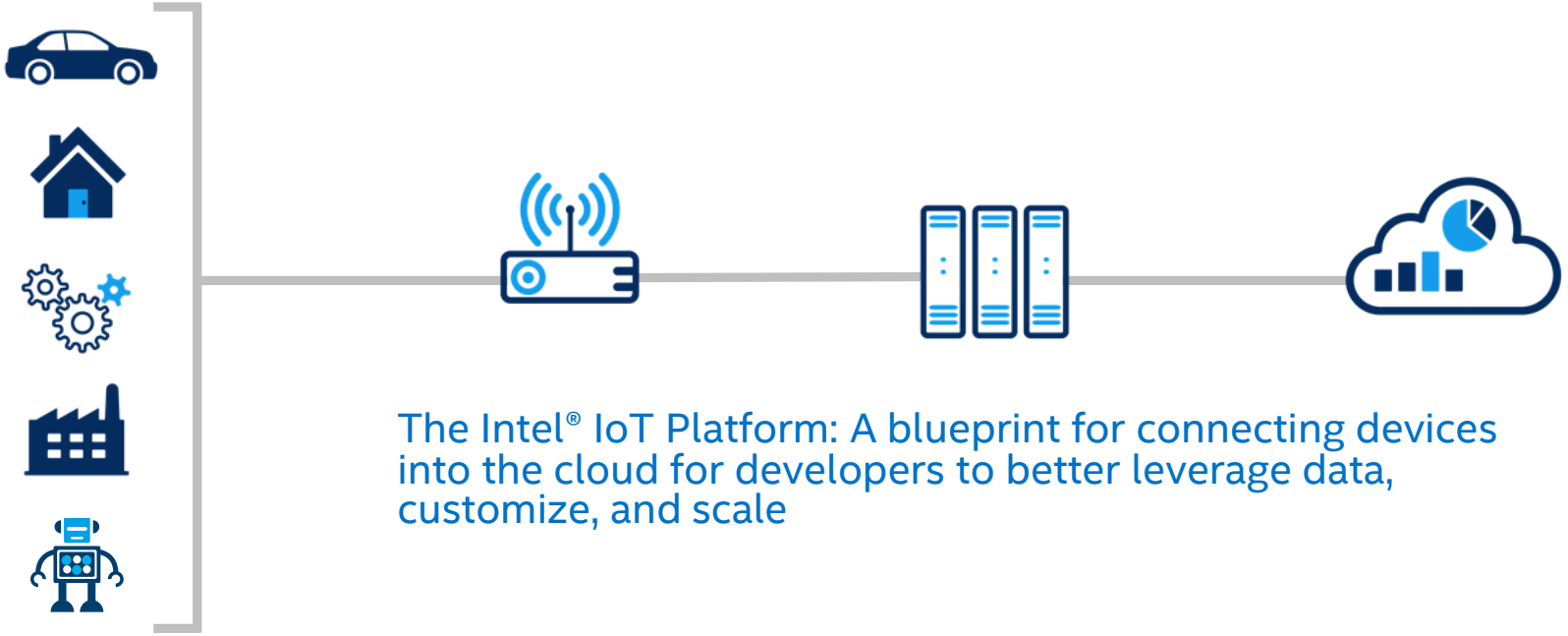
IOT END-TO-END CAPABILITIES

Scalability	Designed to easily grow to meet expanding business needs by moving computation into the cloud.
Interoperability	Applications and services work across diverse platforms using secure APIs.
Manageability	Discovery, provisioning, and management from edge to cloud for secure remote upgrades and services.
Analytics	Unlock data to extract information to make systems work smarter and more efficiently.
Security	A chain of trust that is rooted in the silicon and linked throughout the software.

INTEL® ARCHITECTURE POWERS

Endpoints, Gateways, Networks, and Cloud

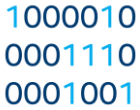
THINGS (ENDPOINTS) | GATEWAY | NETWORK (DATA CENTER) | CLOUD-BASED ANALYTICS



The Intel® IoT Platform: A blueprint for connecting devices into the cloud for developers to better leverage data, customize, and scale

DEVELOPER CHALLENGES

Immature platforms, tools, and standards



Lack of software development knowledge

Lack of hardware development knowledge

Monetization

High production cost

Access to market

INTEL TOOLS—FROM PROTOTYPE TO PRODUCTION

End-to-End Capabilities

- Simplifies the IoT landscape
- Interoperability and open standards across components
- Scale applications and services across diverse platforms

Easy to Use

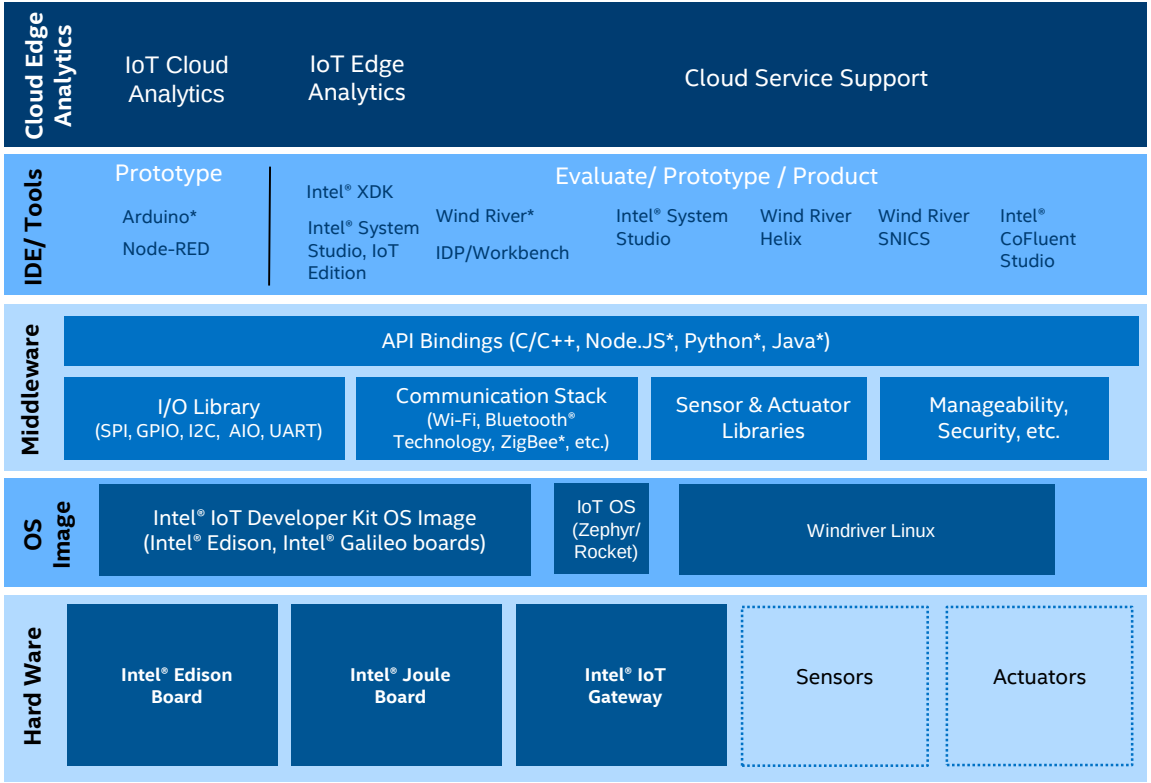
- Solutions to manage the underlying complexities
- Easy-to-set-up, intuitive-to-use IoT platform
- Knowledge, tools, kits, libraries, and a community of experts

Security, Manageability, Analytics

- Centralized control over geographically dispersed assets
- Multilayered, comprehensive security
- Edge and cloud analytics

INTEL® IOT DEVELOPER KIT

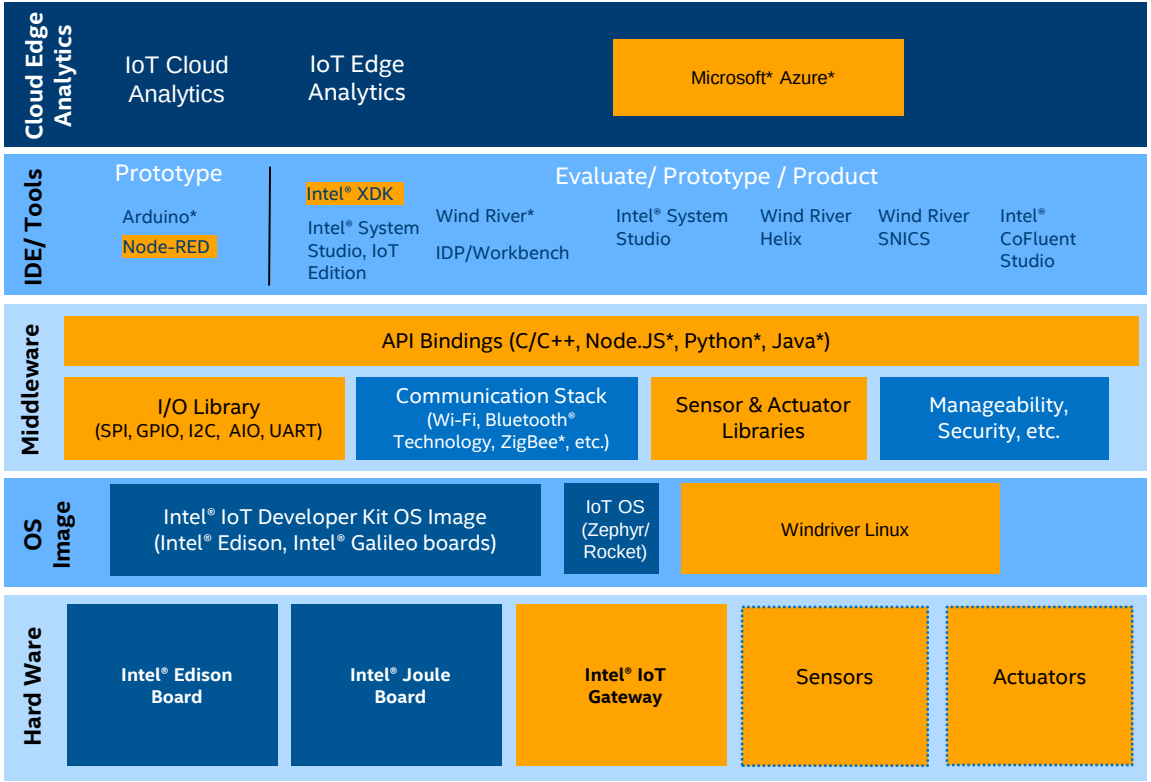
- Supports Intel® IoT Gateways, Intel® Edison and the new Intel® Joule
- Middleware libraries for I/O and sensors or actuators
- IDEs and tools to create, run, debug, and optimize IoT solutions
  - Arduino*, C/C++, JavaScript*, Python*, and Java* programming language support
  - Advanced power efficiency/performance 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



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
- Microsoft* Azure* connection for cloud analytics



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

INTEL® SOFTWARE IOT DEVELOPER PROGRAM

Access knowledge, tools, resources, and a community of experts to help you quickly and easily turn innovative ideas into IoT solutions.

- Product life-cycle support—from prototype to production
- Software tools and environments for creating IoT solutions
- Find and share solutions in the Support Community

https://software.intel.com/iot

Key Developer Program Elements

Intel® IoT Developer Kit

Intel IoT roadshows, hackathons, and workshops

Online community

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)

Intel NUC

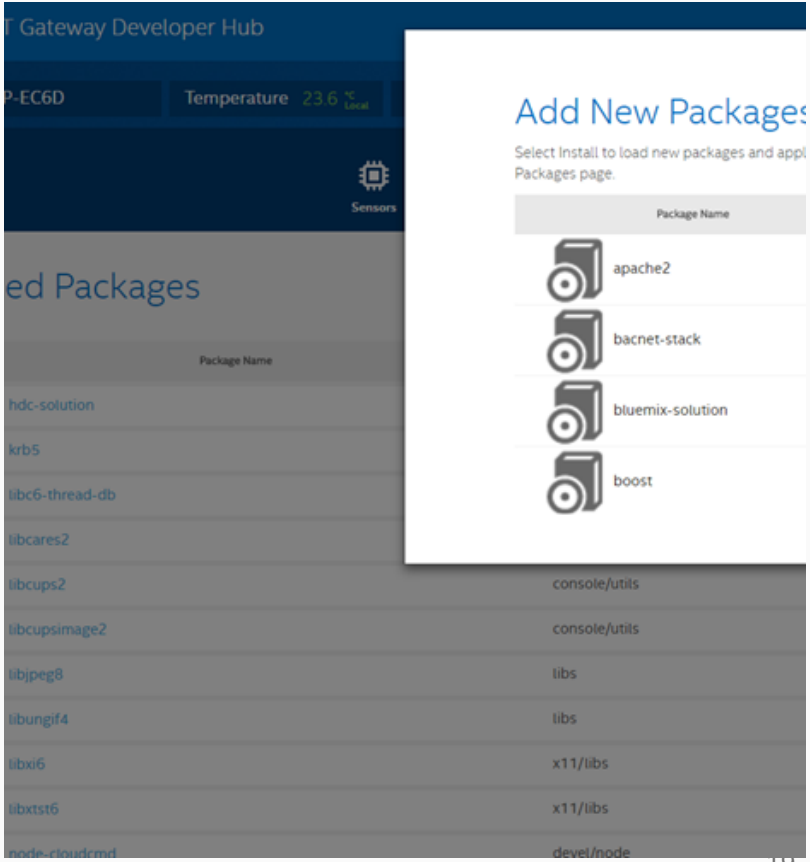
- Runs on Windriver Linux
- Includes Dev Hub, Node-RED, App Cloud, and connectivity to the 01.org repo for additional packages
- Node-RED is the easiest way to get started
- Python, Node.js, Java, and a full C/C++ toolchain are available as well
- libmraa can be used to interface with sensors connected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

Key Features in Windriver Linux

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

IoT Gateway Developer Hub

- 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



IoT Gateway Security

Hardware

Resiliency (Intel® SoC HW root of trust and Grub-IMA)

Secure Boot

What you intend to have booted is what's being booted

Discrete TPM***

Locking and storing private materials inside the trusted platform module

OS and Applications

Resiliency (Intel SoC HW root of trust and Grub-IMA)

McAfee* Embedded Control or Linux* IMA**

Provides system integrity and change control, that is whitelisting

GRSecurity

Allow programs to execute as least privilege policy

Signed RPM Packages

Intel® IoT Gateway confirms signature before it applies RPM system

Data

Data protection (at rest and securing network comms) and resiliency (firewall)

DM-Crypt

SW stack to enable data at rest protection

Open SSL and IPSec VPN

Create private tunnels to raise assurance of the target destination

IPTables

Linux firewall and network routing software

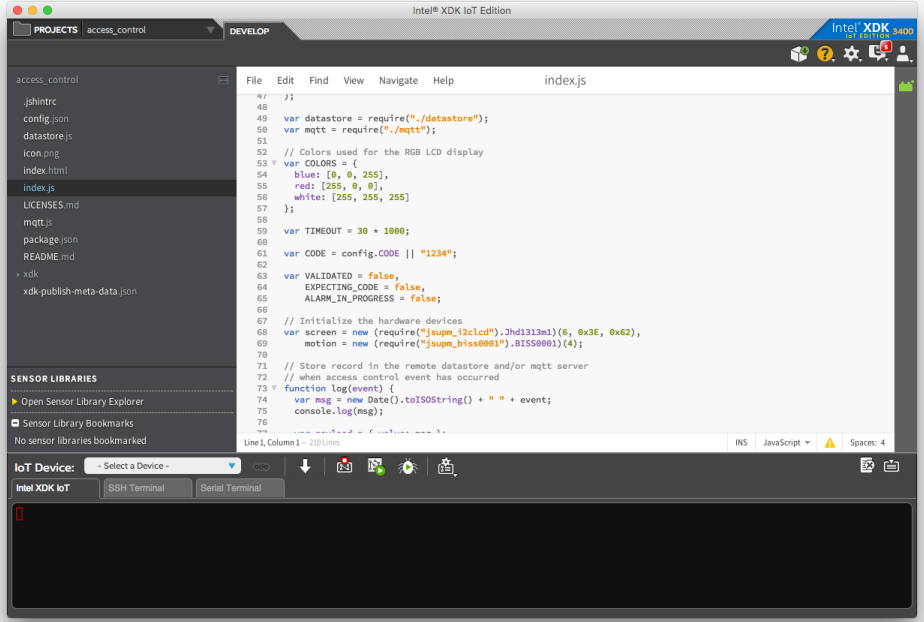
*Protecting the firmware with security rooted in the HW. The ODM must **enable** these features in order to have the OEM realize the benefits

**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



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

Arduino 101

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

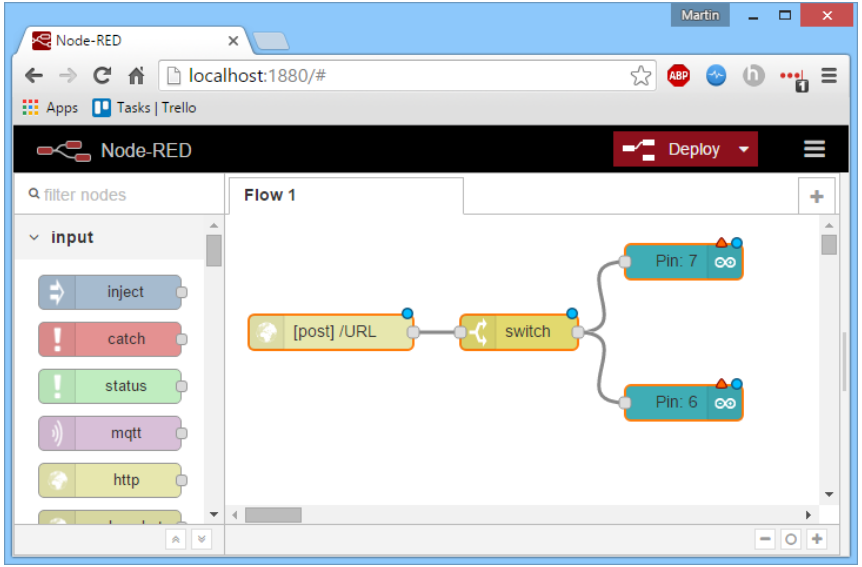
Using Node-RED

Overview and example

What is Node-RED?

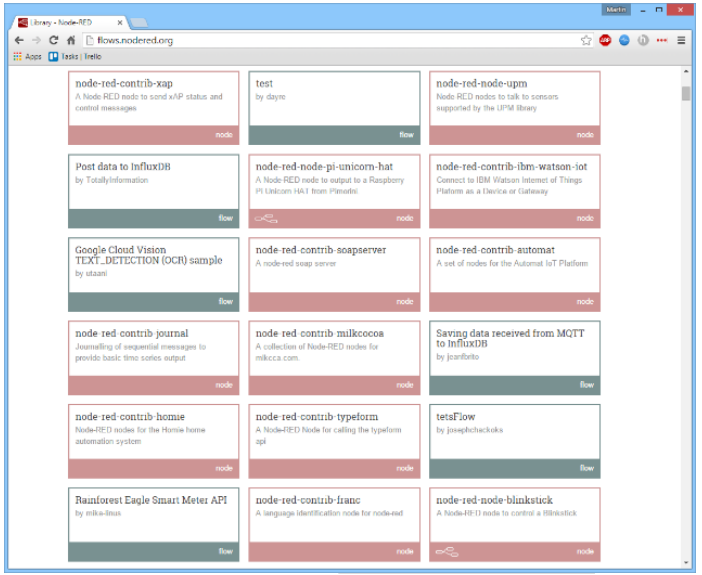
Visual Programming Language built on top of the Node.js runtime

- 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



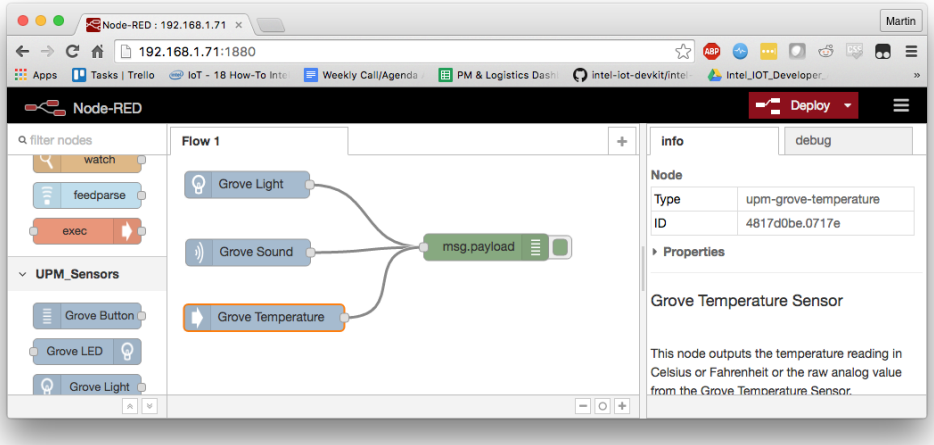
Node-RED Nodes

- 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



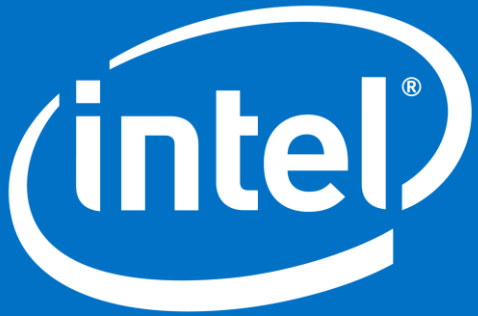
Read Sensor Data with Node-RED

- 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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Software

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