What is an IoT OS?

OIVIND LOE | FEBRUARY 2018
The Infrastructure of the IoT

The cloud – back-end services
- Remote servers
- Business data analytics
- User access and control

Local network – routers / gateways
- Gateway / router
- On-premise “cloud”
- Thing offloading

Things
- Sensors / data capture
- Actuators / manipulators
- Local decision-making
Application

Foundational Software

- Full Upgradability
- Security, Isolation
- Communication

- Dynamic Load/Unload
- Full Process Separation
- Powerful Abstractions

Server / Gateway Hardware

- MMU
- “Unlimited” Memory
- Very High Performance

- Great developer experience
- Great infrastructure / tools
  - AWS, Azure, BlueMix
  - Virtualization, Docker
  - Linux, Android,
  - MySQL, MongoDB, Django, Node.js
  - Python, Go, Javascript
- Focus on problems, not infrastructure

Backend Systems and Routers – Focus on Value Creation
Traditional Embedded System – Constrained Problem

- Limited connectivity
  - Small attack surface
  - Fixed product functionality

- Good tools are available
  - Wide range of IDEs
  - Compilers
  - Debuggers, Analysis

- Often build everything from scratch
  - Devices have one major function
  - Low to medium complexity

Application

Microcontroller Hardware

- (MPU)
- Very Limited Memory
- Limited Performance
Current IoT End Nodes – Build Everything from Scratch

- Connectivity adds complexity
  - Evolving customer expectation
  - Exposed to the world
  - Hackable

- Tools are available
  - Network analyzer
  - Security libraries

- Building everything in-house is fun
  - Reinvent the wheel
  - Challenges down the road
  - Less effort spent on product value

### Application

- Full Upgradability
- Security, Isolation
- Communication

### Wireless Microcontroller Hardware

- MPU
- Very Limited Memory
- Very Limited Performance
The IoT OS – Focus on Value Creation

- Remove complexity of connectivity
  - Built-in connectivity
  - Secure by default
  - Lifecycle management
- Accelerate development
  - Great observability and debug
  - Built-in utilities and drivers
  - Optimized to target architectures
- Allow developers to focus on value creation

<table>
<thead>
<tr>
<th>Application</th>
<th>The IoT OS</th>
<th>Wireless Microcontroller Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Upgradability</td>
<td>MPU</td>
</tr>
<tr>
<td></td>
<td>Security, Isolation</td>
<td>Very Limited Memory</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>Very Limited Performance</td>
</tr>
</tbody>
</table>
Modularity / Scalability

- Core OS
- Zigbee Stack
- BLE 5.0 Stack
- Application
- File System
- Secure Boot
- GUI

Customer Stacks
TCP/IP
Thread
Wi-Fi
CAN
Connectivity

SENSE

SENSOR I/F

MCU ARM

MULTI PROTOCOL RADIO

ENERGY MANAGEMENT

MEMORY

MIXED-SIGNAL

RF

CONTROL

THREAD

zigbee

Bluetooth

Proprietary wireless

WiFi

ETHERNET

Certified

USB
Security

- Insurance policy
  - Required capabilities not understood by consumers
  - Difficult to market and sell
  - Low impact on direct consumer value

- Addresses negative external events
  - Attack could impact brand value & consumer trust
  - Cloning could reduce revenue
  - High impact on long term company performance

- Needs to be easy to implement
  - Not get in the way of the developer
  - Facilitated by the OS
Proper Usage of Power Management Hardware

- Modern wireless MCUs excel low power
  - Voltage scaling
  - Multiple energy modes
  - Autonomous peripherals

- Must make low power painless
  - Fully supported by OS
  - Enabled by default

- Examples
  - Tickless operation
  - Energy mode awareness
  - Low entry/exit overheads
An OS for IoT Devices

- The IoT Devices also need a proper OS
  - Simplify development
  - Provide important services
  - Reduce risk of large deployments

- Unique challenges
  - Hardware constraints driven by cost and battery life
  - Connectivity and security
  - One OS across wide variety of hardware

- Lays groundwork for even better devices
  - Focus on customer value
  - Robust and secure by default
  - Paving the way for Billions of devices
Thank You

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