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Implementing Energy Efficient IoT Devices Using Modular Platforms

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Pavan Mulabagal is part of the IoT strategy and marketing team at ON Semiconductor. In this role, he's responsible for driving IoT initiatives, customer and partner engagements, and evangelizing ON Semiconductor's IoT products and solutions spanning everything from sensors to connectivity solutions, actuators and SoCs. Prior to ON Semiconductor, Pavan spent close to a decade at Qualcomm where he created product and technology roadmaps, established strategic partnerships, and formulated go-to-market strategies. During his seventeen plus years in the high-tech industry, Pavan has launched a number of wearable, mobile, consumer and networking products. Pavan holds an MBA from Haas School of business, Berkeley and a BSEE from the Indian Institute of Technology.

Introduction

Deployment of the Internet of Things (IoT) is gaining real momentum, with new technical advances in sensing, and emerging communication protocols set to help push its progression. The multi-disciplinary nature of IoT requires a broad set of competencies that organizations with limited resources or experience of connecting their equipment to the cloud may find challenging. Battery life or device autonomy is yet another challenge when it comes to ensuring faster adoption of IoT across various verticals.

IoT nodes at the edge of the network where data acquisition and/or actuation activities occur, are often battery powered. The impracticality and maintenance cost of frequently replacing batteries is a non-starter for many IoT applications. Nodes deployed in remote locations further compound this problem.

For potential users and solution providers of the IoT, understanding connectivity technologies that deliver highly efficient operation, such as Bluetooth® Low Energy (BLE) or Low Power Wide Area Network (LWAN) technology, is essential. Additionally, innovative battery-free sensors such as Smart Passive Sensors (SPS) from ON Semiconductor that work by harvesting UHF RF energy eliminate any concerns around battery life management. They enable maintenance free operation and also allow monitoring of hard-to-access areas.

A Bluetooth Low Energy Ecosystem

Bluetooth Low Energy technology is one of the most popular communication protocols within smart homes, building automation, smart retail, digital health and other IoT verticals. The availability of Bluetooth on just about every smartphone and tablet, and feature enhancements of the protocol make it ideal for use at the edge of IoT networks.

BLE introduced the idea of transmitting small packets of data and then entering a sleep mode, dramatically reducing the overall power consumption. This mode of operation is ideal for sensor nodes, where constant data streams are unnecessary. With a connectionless model, wider channels, shorter packets and a simpler stack, BLE has been optimized for energy efficiency. In order to further aid the IoT paradigm, new network topologies such as broadcast, mesh and stronger security features including 'Man in the Middle' protection and AES-128 encryption have been added to the BLE specification.

The latest update - Bluetooth 5 - was again a major step forward in delivering IoT-related functionality and performance. Bluetooth 5 increases the peak bandwidth to 2 Mbps and extends the range by 4x, reaching a theoretical figure of 300 meters. Of particular significance for IoT applications is the ability of Bluetooth 5 to be configured as a mesh network rather than requiring a central hub – this dramatically increases the potential coverage and makes the network more resilient.

With the industry's lowest sleep and receive power, RSL10, a multi-protocol Bluetooth 5 certified SoC from ON Semiconductor, is ideal for BLE battery powered applications. RSL10 also scored an impressive 1000+ points (the higher the score, the lower the power consumption) on the ULPMark ®, an industry standard benchmark for embedded systems (https://www.eembc.org/ulpmark/index.php). The Cortex-M3 core along with a 32-bit low power DSP core, a wide input voltage range, embedded Flash and the ultra-miniature size of RSL10 provide great design flexibility.

Smart Passive Sensors – opening up IoT opportunities

Extending the concept of ultra-low power operation and convenience, ON Semiconductor's SPS technology is entirely wireless – both for data transmission and for the miniscule amounts of power required for it to function.

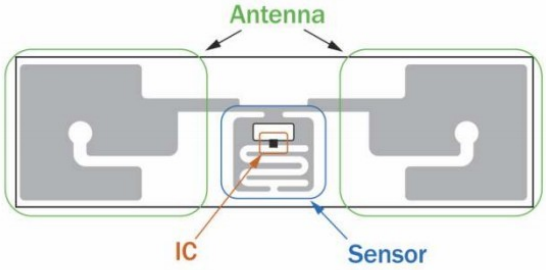

Figure 1: SPS technology is entirely battery-less and wireless

SPS 'tags' can monitor environmental parameters such as temperature, pressure and moisture that are key to many IoT applications. They contain an ultra-thin IC that manages power, RF connectivity and sensing without requiring a microcontroller. These devices harvest power from UHF RF transmissions, so simply bringing an RF reader into proximity is all that is required to make them function.

Given their small size, low cost SPS tags have the potential to revolutionize IoT by allowing sensing in previously hard to access areas. They are particularly applicable in areas where battery use and replacement is impractical, such as being embedded in walls or floors.

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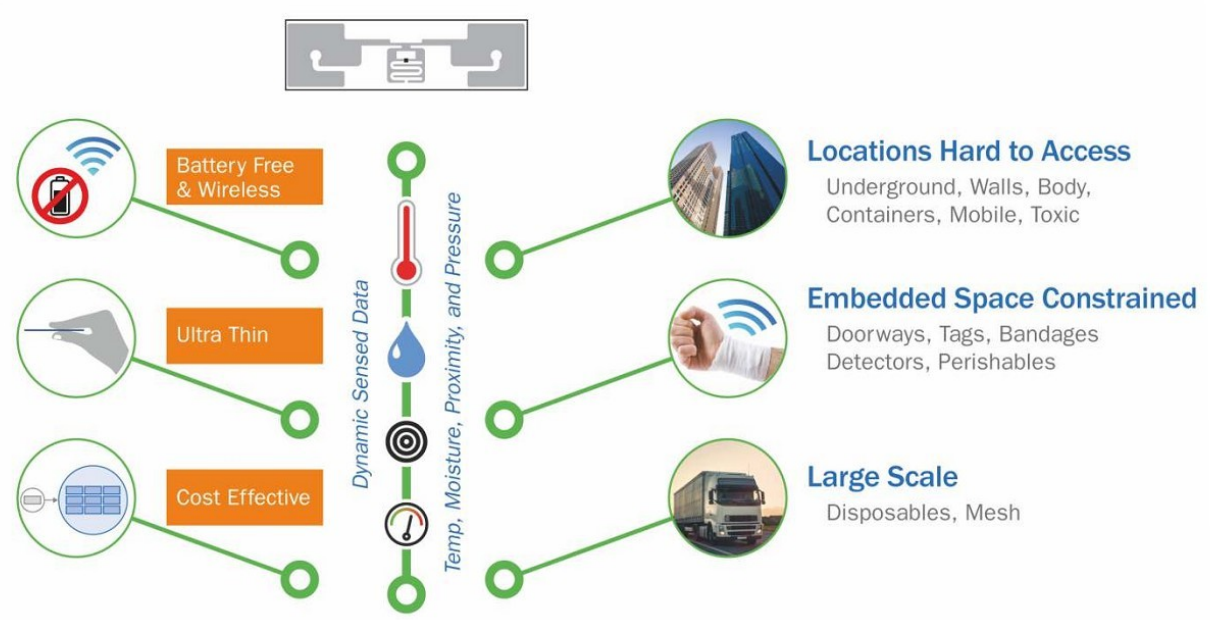

Figure 2: SPS technology enables a whole new approach to IoT sensing

SPS tags are completely safe for use in patient-contact medical applications and their low cost allows them to be utilized in large-scale, disposable applications, such as for the monitoring of food in transit. In disposable applications, the fact that SPS tags do not require a battery both saves cost and also any environmental issues associated with battery disposal.

A helping hand for IoT development

Efficiency gains, cost savings and increased revenue streams are being realized across verticals that have embraced the concept of IoT. However, many organizations that see the potential benefits of IoT still continue to wait on the sidelines. This is partly due to the steep learning curve as the breadth of technologies involved in delivering a viable IoT solution is large.

While the specific challenges will depend upon the application, they will likely involve picking the right connectivity, sensing, actuation, power management and cloud services and data security solutions. A platform that provides the ability to rapidly try out various options is indispensable in arriving at the optimal choice of various functional blocks to meet the application goals.

By its very nature, the IoT is flexible and any successful development tool must match this flexibility, allowing engineers the ability to tailor their designs and merge hardware and software to meet application needs within a single, integrated development environment.

The IoT Development Kit (IDK), ON Semiconductor's award winning, modular, node-to-cloud rapid prototyping platform is extremely flexible and enables easier development of several IoT use cases. The IDK offers multiple connectivity, sensing and actuation options that provide the user the flexibility to tailor solutions according to the demands of the industry vertical. The comprehensive kit enables 'device to cloud' applications out-of-the-box and includes an IDE, multiple cloud connectivity options and over forty use cases that customers can build upon.

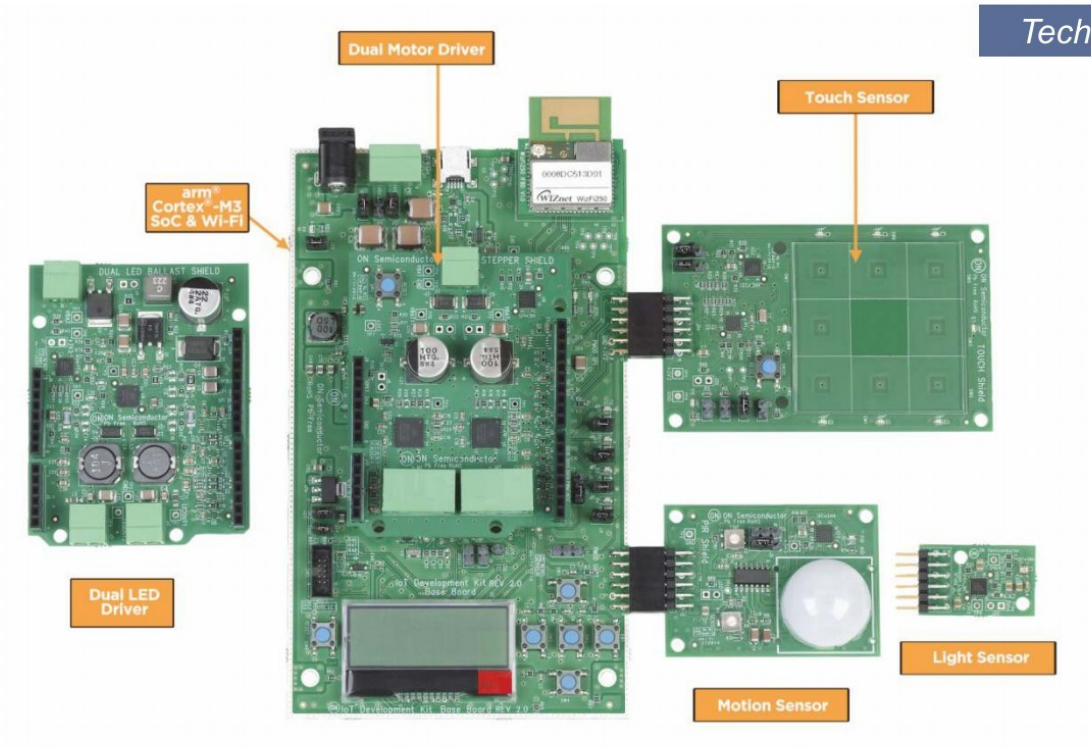

Figure 3: ON Semiconductor's IDK adopts a versatile modular approach

The main processing element of the IDK is ON Semiconductor's NCS36510, a low power, fully integrated, System-on-Chip (SoC) that includes a powerful 32-bit Arm® Cortex®-M3 processor, and associated memory and peripherals.

The main baseboard connects to a wide range of daughter cards ('shields') to expand functionality. For connectivity, engineers can pick daughter cards for various wireless and wireline communication protocols, such as BLE , Wi-Fi, 802.15.4 (ZigBee, Thread), Sigfox, CAN bus and Ethernet. For sensors, there are daughter cards that incorporate temperature, motion, moisture, ambient light, pressure and bio sensors. In addition, actuator functionality can be added through the stepper, brushless motor drivers, and LED driver shields.

An SPS shield further enhances the value of the IDK allowing data capture from battery-free wireless sensors, to enable measurement of temperature, moisture and pressure at the network edge with a high level of convenience. The kit was recently expanded with the launch of a new multi-sensor shield and a mobile app. The new shield combined with the previously launched IDK shields enables rapid prototyping of several IoT applications including connected wellness, industrial wearables, smart home devices, asset tracking, etc.

Full IDK shield documentation including design schematics, PCB layouts and Gerber files are available to support the rapid transition of designs from concept to production.

Summary

The IoT offers a huge opportunity for organizations to broaden the value and capabilities of their product offerings. The breadth of sometimes unfamiliar technologies that are incorporated into successful IoT implementations can often prove challenging, especially to new market entrants.

Development kits and tools can offer an infinitely expandable, highly flexible development

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ecosystem that benefits both new and experienced designers. By incorporating many advanced low power technologies including BLE and SPS in an intuitive 'package', kits such as the IDK can provide a risk-free way to rapidly develop the hardware and software aspects of IoT solutions all the way from the node to the cloud.

ON Semiconductor is committed to providing a broad portfolio of low power sensing, power management, control and connectivity solutions. Comprehensive end-to-end development kits incorporating the low power portfolio aid customers in rapidly prototyping relevant IoT use cases, reduce time-to-market and launch long battery life products.