

## **STMicroelectronics: Providing all the building blocks for “Smart Things” in the “Internet of Things”**

The “Internet of Things” (IoT) is opening the potential for billions of “smart” things to communicate with each other using the nearly ubiquitous Internet Protocol technology. From sports aids that monitor performance to traffic lights that switch to keep traffic flowing, these smart things are changing our world.

The IoT’s contributions to improving daily life are already numerous and should radically influence our future with applications targeting the most pressing societal and environmental challenges. While estimates vary, as many of 45 billion IoT connected devices are expected to be in service by the end of 2020. And STMicroelectronics is already at the forefront in this wave of innovation by providing the simplest way for all customers, from the smallest start-ups to global industrial giants, to develop new devices and applications for the IoT

A key factor enabling the rapid expansion - and acceptance - of IoT is the enormous progress ST and other semiconductor companies have made with their technologies. These advances in turn, are enabling the design of “smart things” that are powerful, compact, energy-efficient, secure and affordable enough to provide new capabilities on a large scale and have unleashed the world’s vast creative potential.

The first wave of Internet technology connected people to people and people to organizations via applications like email and web sites. We quickly saw how this transformed our lives by, for example, making it more convenient to bank, simpler to book travel, and easy to find and listen to music. The IoT takes this much further by enabling almost everything we use, rely on, or touch, including streetlights, jewellery, home appliances, health aids, our vehicles, and even the paper we use, to become “smart things.”

### **What is a “Smart Thing?”**

A “smart thing” can sense, monitor and react to its environment, securely processing the information it collects, protected from threats and intrusions, then communicating the results to other smart objects while managing its own--and, sometimes other smart objects’--power consumption.

ST today has all the ingredients – sensors and actuators, microcontrollers, power and analog components, and connectivity products, to build these Smart Things.

(1) A smart thing senses its environment and can act on its environment  
Since ST launched the “consumerization” of the micro-electro-mechanical systems (MEMS) in the mid-2000s, we’ve made enormous progress in developing compact, accurate, low-cost silicon sensors and actuators. From tiny silicon cameras to miniscule sensors that measure motion such as linear or angular acceleration or pressure, temperature, humidity, and light to understand the environment, IoT designers can now draw upon an ever-increasing toolkit of effective silicon sensors, along with the sensor-fusion technology to coordinate outputs while compensating for drift and degradation. ST is the only supplier with the full range of sensors. We also offer actuators, such as micro-mirrors that can be used in heads-up displays and projectors, among other applications.

(2) A smart thing has a brain to secure and process information

To be “Smart,” all IoT applications need a compact, low-power and affordable brain. Today, even the most economical STM32 microcontroller, available for well less than US\$1, offering processing power orders of magnitude greater than was used to land the first man on the moon, customers typically point to software and system development as more challenging than processing capabilities. Meeting performance, power, and development needs, ST has recognized that delivering simplicity, ease of use, power efficiency, and secure features across a broad range of processors with SW and HW compatibility is a key differentiator.

(3) A smart thing is connected to the outside world

An essential feature of smart things is their ability to communicate to users and with other smart things. Increasingly, they do this via wireless connections, to other smart things via Bluetooth or other established protocols that connect them to a personal mobile device (phone, tablet) or wider network (industrial applications) that provides Internet or network connectivity.

(4) A smart thing is energy-efficient and energy-savvy

Some smart things manage other smart things (e.g. by turning on a light or controlling a motor) and all smart things should monitor and optimize their own power consumption to suit demand, cost, and performance requirements. Ultimately, to achieve the goal of a smart environment for example, sensors must be everywhere and do more with less, in order to reduce global power needs and be self-sustaining. This requires advances in power conversion, energy harvesting and flexible batteries, such as ST’s EnFilm™ thin-film battery.

All of these elements combine to create an IoT domain where the Things can be broadly divided into three main areas:

(a) Smartphones and Tablets, which are the hubs through which many smart things connect to the Internet. Today’s smartphones are no longer primarily used for voice communication; instead, they give their owners the ability to listen to music, play games, browse the Internet, engage in social media activities and, generally, interact with the world in ways that a generation ago would have seemed impossible.

(b) Wearables, which is the collection of “Smart Me” applications around the body that enhance life by monitoring and tracking useful location, health/wellness, and environmental information. These often—but not always or necessarily—link to the Internet through the wearer’s smartphone. Market analysts IHS estimates that over 50 million wearable devices were sold in 2015 – and this is a market that is still in its infancy!

(c) “Other Smart Things,” which embrace the vast universe of “Things” in our homes, in our offices and factories, on the streets, or in our cars that, by connecting to the Internet and being able to access and share information, augment productivity, security, and convenience. These add value across the full range of sectors from IT and Networking to Buildings, from Retail and Industrial, to Transportation, Energy, and Public Safety—a strong reason why McKinsey estimates the potential impact of the IoT at as much as 11 Trillion dollars per year in 2025<sup>1</sup>.

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<sup>1</sup> The Internet of Things: Mapping the Value Beyond the Hype; June 2015, McKinsey Global Institute.

## Why ST for IoT?

ST is committed to using its technologies and expertise to help its customers transform the world for the better. Today, ST offers the simplest way for designers and makers of smart things to develop or enhance their solutions using its comprehensive portfolio of products that provide industry-leading performance covering all key functions (intelligence with security, sensing, power management, analog, and connectivity); ST is a world leader in many of them. For example, ST is the world's number 1 supplier of sensors for Consumer and Mobile applications<sup>2</sup>, and of AMOLED power supplies for smartphones<sup>3</sup>, and among the leading suppliers of ARM® Cortex®-M MCUs.

In addition, ST has a design ecosystem, including open platforms and jump-start licensing that makes it simple and easy for customers to rapidly evaluate, prototype and commercialize innovative new applications, where the time-to-market is critical.

As an example, the STM32 Open Development Environment, built around the STM32 32-bit microcontroller family, provides a simple and affordable way for anyone to start developing their great ideas into innovative devices and applications with state-of-the-art ST components which include a comprehensive set of functions for sensing, connectivity, power, audio, motor control, and more.

The combination of a broad range of modular hardware based on leading-edge commercial products and comprehensive software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs. Moreover, ST offers a growing set of reference designs for many applications to make the transition from prototype to final product even smoother.

Pervasive connectivity is transforming the world. ST is committed to using its technologies and expertise to help its customers transform the world for the better.

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<sup>2</sup> Source: IHS Consumer and Mobile MEMS Market Tracker H1 2014.

<sup>3</sup> Source: IHS, ST