



## Internet of Things Standards

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### Executive Summary

The Internet of Things (IoT) juggernaut, driven by innovative and visionary vendors, is moving swiftly and making inroads by vendors putting stakes in the ground and establishing *de facto* standards. On the other hand, the standards bodies trying to establish *de jure* standards are, as always, scrambling to influence the direction the industry is heading towards. In the long run, we hope organizations such as the ETSI, IEEE, and IETF will take leadership roles and develop standards acceptable to consumers, enterprises, industries, and vendors alike to ensure interoperability in the highly heterogeneous IoT world. Otherwise, we'll have Io[s&\*]T!

### 1. Introduction

Kevin Ashton supposedly coined the phrase "Internet of Things" while working for Procter & Gamble in 1999. He later co-founded the [Auto-ID Center](#) at the Massachusetts Institute of Technology. But IoT standards efforts didn't begin in earnest until early 2013, by which point it might have already been too late. The fast-moving tech industry doesn't wait for often-bloated and bureaucratic standards bodies' slow progress in developing *de jure* standards, but move ahead developing and delivering products that often become *de facto* standards. Remember the battles of Betamax vs. VHS, 8-track vs. Compact Cassette, and X/Open vs. OSF. Similarly, while many IoT standards bodies are still establishing guidelines, aggressive, creative, and innovative vendors are brining interesting products to the market. It is too early to guess which standards—*de facto* or *de jure*—will eventually rule the IoT world.

### 2. Why do we need Standards?

Do we need standards at all? With billions and billions of things, devices, and people of all shapes, sizes, and pedigree expected to come online during the next decade, standards are essential to enable interoperability, promote trust, and enhance security. Just take a look at the simple electric plug and socket. Even though we take their functioning for granted, there are [15 different types](#)—A through O—of plug and socket in use around the world! That's why you need adapters when you travel overseas.

There are some skeptics who question the very relevance and value of standards. Marc Jensen, CTO, [space150](#), and a serious IoT hacker, says, "It's still the wild, wild west out there." Matti Kon, founder and CEO, [InfoTech Solutions for Business](#), a systems integrator, adds, "We're trying to close the doors of the barn after the horses are already out."

A crucial thing to understand is that the IoT requires tons and diverse types of technology to work—wireless, machine-to-machine, machine-to-man, and man-to-machine communications, data geofencing, governance, integrity, and security, to name a few. It is unlikely a single standard will cover *all* these, any more than a single standard covers the way your laptop or tablet works. But we believe efforts to develop and promote standards are steps in the right direction.

### 3. Standards

We discussed [AllSeen Alliance/Alljoyn](#) (AA), [Industrial Internet Consortium](#) (IIC), and the [Open Connectivity Foundation](#) (formerly, Open Interconnect Consortium) with its IoTivity framework previously in our earlier report on [IoT Interoperability](#), but we will take a closer in the following paragraphs on other emerging standards, although none of them are really fully established or widely embraced.



### 3.1 Apple HomeKit

This is Apple's proprietary framework for communicating with and controlling connected accessories in a user's home (Figure 1). Its main features are that it:

- communicates with and controls connected accessories in a user's home and serves as the central software hub for the smart devices.
- enables each device in the home that is connected to be a smart device. These devices then communicate to the smart hub.
- is Licensed under the [MFI \("Made for iPhone/iPod/iPad"\) licensing program](#)
- lets application developers and hardware manufacturers to either choose to join the club or stay outside the walled garden.

For consumers, the label HomeKit means the device (say, a smart light bulb) will work seamlessly with an iPhone and Siri.

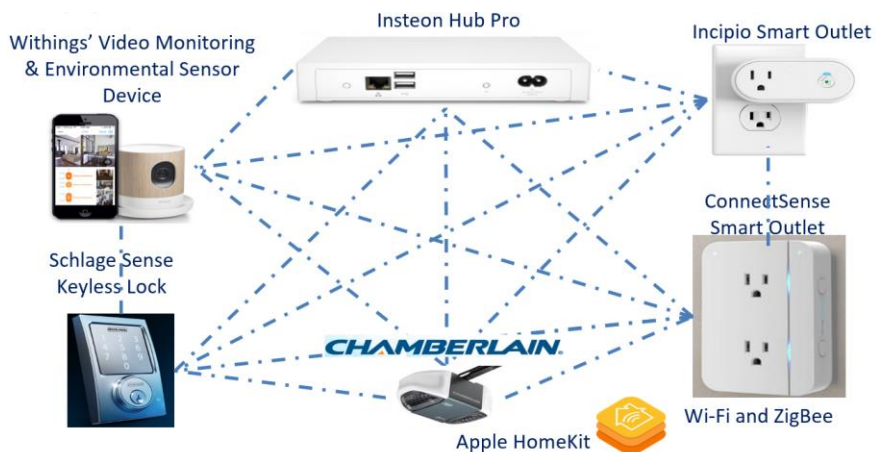


Figure 1. Apple HomeKit

More recently, homebuilders, for instance, [Brookfield Homes](#) in the U. S., have begun to adopt HomeKit, based on the confidence that a set of devices will work within a specific platform. Brookfield Homes in Southern California will offer built-in HomeKit infrastructure later this year (Figure 2). So, rather than the owner adding smart home gadgets such as automated locks, cameras, blinds, thermostats, and air quality monitors to a home piece by piece, homebuilders can install the devices before you move in and ensure the infrastructure is equipped to handle them.



Figure 2. Brookfield Homes in Southern California<sup>1</sup>

<sup>1</sup> "You'll soon be able to buy a HomeKit-powered 'Apple House'," Samantha Murphy Kelly, *Mashable*, June 15, 2016.



Apple's insistence on cutting-edge 3072-bit encryption keys and Apple-certified chips used by Wi-Fi and Bluetooth devices is holding back its widespread adoption. It's worth noting HomeKit is **not** a standard, but just a framework.

### 3.2 IEEE P2413

In the [IEEE](#), there are more than 350 IEEE standards that are applicable to IoT, 40 of which are being revised to better support IoT. Furthermore, there are more than 110 new IoT-related IEEE standards in various stages of development. The IEEE is also sponsoring 10 or more different IoT advocacy and support groups.<sup>2</sup> "You want a Standard? We got a Standard!"

[IEEE P2413](#) serves as the umbrella for all this and its goal is to build a reference architecture that covers the definition of basic architectural building blocks and their ability to be integrated into multi-tiered systems. P2413 is building liaisons with the IIC, oneM2M, and several other IoT working groups.

### 3.3 IoT Working Group

The [IoT WG](#) is a collaborative effort between organizations and individuals who share the goal of creating an open IoT. The collaboration focuses on the development, promotion, and adoption of open source IoT technology. Many of its members provide a wide range of projects and services built on top of Eclipse IoT technology.

The relevant standards from this organization are:

- CoAP (Constrained Application Protocol), a protocol specialized for use with constrained nodes and networks. It implements the REST architectural style and can be transparently mapped to HTTP. However, CoAP also provides features that go beyond HTTP such as native push notifications and group communication.
- ETSI SmartM2M provides specifications for M2M services and applications, and particularly focuses on aspects of the IoT and Smart Cities.
- MQTT, a lightweight pub-sub protocol designed to connect the physical world devices and networks, with applications and middleware used in IT and Web development, making it an ideal connectivity protocol for IoT and M2M.
- OMA LightweightM2M, an industry standard for device management of M2M/IoT devices. It heavily relies on CoAP and is optimized for communications over sensor or cellular networks. OMA LWM2M provides an extensible object model that allows to enable application data exchanges in addition to the core device management features (firmware upgrade, connectivity monitoring...).

### 3.4 ITU-T SG20

Established in June 2015, the International Telecommunication Union [ITU-T SG20](#) is an emerging standard that is designed not only to cover the IoT but also "smart cities and communities". The SG20 standard is responsible for international standards to enable the coordinated development of IoT technologies, including M2M communications and ubiquitous sensor networks.

One problem with the ITU-T standards is the lack of any significant U. S. involvement, but nonetheless we believe it will emerge since ITU has the most authority on a global scale. Unfortunately, ITU is still in the study phase, when the world is aggressively implementing IoT.

### 3.5 Samsung SmartThings

Akin to Apple's HomeKit, Samsung offers its own proprietary SmartThings framework (Figure 3). This is Samsung/Android vs. Apple iOS *déjà vu* battle all over again. Samsung hopes to capitalize on its huge market presence in home appliances—TVs, washers, dryers, fridges, microwave ovens, ranges, dishwashers, vacuum cleaners—to gain a foothold in the consumer IoT space.

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<sup>2</sup> [""Home, Tweet Home": Implications of the Connected Home, Human and Habitat on Australian Consumers,](#)" Alexander Vulkanovski, ACCAN Intern (of Things), February 2016.

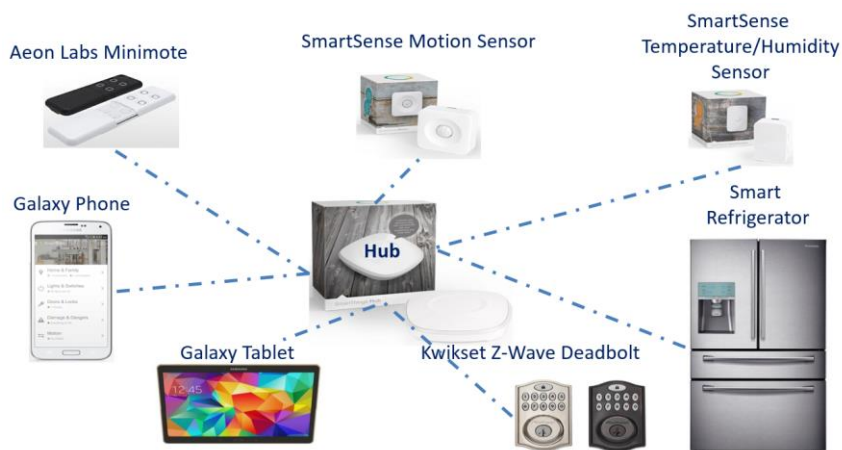


Figure 3. Samsung SmartThings

### 3.6 Thread

[Thread](#) is one of the newest standards bodies formed with one goal in mind: [to create the very best way to connect and control products in the home](#). It was founded in July 2014 as a collaboration effort between Google's Nest division and ARM, [Big Ass Fans](#) (don't laugh), Freescale, Nest, Samsung, [Silicon Labs](#), and [Yale](#).

Built on open standards and IPv6/Low-power Wireless Personal Area Networks (6LoWPAN) protocols, first chartered by the [IETF in March 2005](#), it claims:

- Its approach to wireless networking offers numerous technological advantages, including a secure and reliable mesh network with no single point of failure, simple connectivity, and low power.
- Thread networks are easy to set up and secure to use with banking-class encryption to close security holes that exist in other wireless protocols.
- It differentiates itself from other protocols by relying on 6LoWPAN. Thread said in a [press release](#) this will involve mesh networks that “scale to hundreds of devices with no single point of failure” and which feature “banking-class encryption.”

### 4. Conclusions

It's quite obvious from the above discussions that there are no leaders or laggards in the IoT standards space—yet. The industry is just evolving and only time will decide the winners and losers. Also, real money will be made in the industrial IoT space and not in the much-hyped consumer market, despite eye-popping market forecasts by industry analysts and pundits. Vendors wishing to prove their worth in the IoT space must develop and deliver products and solutions that help enterprises improve operational efficiency, reduce CapEx and OpEx, enhance customer/user experience, and increase profitability.