



# Chapter 30

## Challenges and Trends in Home Automation: Addressing the Interoperability Problem With the Open-Source Platform OpenHAB

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### ABSTRACT

*Home automation (HA) systems can be considered as an implementation of the internet of everything (IoE) where many devices are linked by intelligent connections in order to improve the quality of life at home. This chapter is dedicated to analyzing current trends and challenges in HA. Energy management, safer homes, and improved control over the house are some of the benefits of HA. However, privacy, security, social disruption, installation/maintenance issues, economic costs, market fragmentation, and low interoperability represent real problems of these IoE solutions. In this regard, the latest proposals in HA try to answer some of these needs with low-cost DIY solutions, wireless solutions, and IP-based HA systems. This chapter proposes a way to deal with the interoperability problem by means of the open-source platform openHAB. It is based on the concept of a home automation bus, an idea that enables the separation of the physical and the functional view of any device, allowing to create a technology-agnostic environment, which is perfect for addressing the interoperability problem.*

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## INTRODUCTION

The vision of a smart home that takes advantage of the latest advances in digital and information technologies - being able to anticipate our actions and satisfy our needs through intelligent or automatic actions - has been around for decades. The idea of bringing computers to our background in a *ubiquitous computing* paradigm was forecasted in 1991 by Weiser (Weiser, 1991), so that computers would increasingly enable the integration of simple objects, such as clothing labels, key fobs, light bulbs, etc. in an unobtrusive way in the user's life (Toschi, Campos, & Cugnasca, 2017). This vision is indeed very appealing and seductive, since it has an enormous potential in improving our daily life, saving time, money and energy, improving home comfort, safety, security, health care, weather-awareness and many other aspects.

With homes implementing Internet of Things (IoT) scenarios, this smart home vision is closer to reality than ever. The IoT is envisioned as a network that allows everyone and everyday objects to be connected anytime and anyplace. Smart homes can be seen as an interactive people-centric application of IoT, which is aimed at improving the quality of life (Feng, Setoodeh, & Haykin, 2017). The decrease in electronic hardware production costs is causing the number of IoT-capable devices to grow at astonishing rates. In fact, the number of IoT devices has already well exceeded the number of human beings living in our planet (Swan, 2012). Therefore, home automation is expected to benefit from this new digital revolution. Although not all smart home technologies provide direct communication between their devices and the Internet - gateways are needed in most systems -, smart home networks are considered IoT applications.

However, a smart home is much more than a building with connected digital components. Since many devices are connected together for a common purpose, in an orchestrated, convergent way, this smart home vision clearly represents an example of the Internet of Everything (IoE) paradigm, where individual devices are meaningful only in the context of the intelligent network in which they work, connecting data, processes, things and people.

There is not a standard or fixed definition of the term *smart home*. In fact the concept of *home* has many different connotations and meanings, as opposed to house/building (Gram-Hanssen & Darby, 2018). Nevertheless, it is widely accepted that a smart home is one (leaving aside the sociological connotations about the word home) that incorporates automation systems to provide its inhabitants with remote control and sophisticated monitoring over the building. A possible definition is "a dwelling incorporating a communications network that connects the key electrical appliances and services, and allows them to be remotely controlled, monitored or accessed." (Ye & Huang, 2011). This definition does not include an intelligent/smart behavior or even automations, but it is understood that a smart home is able to perform automatic programmable actions on behalf of their inhabitants and without human intervention. This ability is known as *home automation* (HA) and opens the possibility to treat the house as a digital system where all computer science paradigms can be applied, including artificial intelligence, machine learning, data mining, automatic reasoning or even big data. Although home automation and smart home do not refer to the exact same thing, they are often considered as synonyms (Stojkoska & Trivodaliev, 2017).

History on HA can be traced back to the final decades of the 19<sup>th</sup> century. Although no digital technology was involved, the comfort increase provided by the introduction of electricity at home in the late 1800s was significant. Of course, the concept of highly-automated digital home available for a mass market that we identify today as a smart home came only in the final quarter of the 20<sup>th</sup> century (Gram-Hanssen & Darby, 2018).

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