Chapter 7
Evolution of the Smart Spaces Paradigm Toward the Semantic Web of Things

ABSTRACT
This chapter describes how the Smart-M3 platform evolved in the direction of supporting web standards (e.g., HTTP and Websockets) to be ready for the (Semantic) Web of Things. The latest step in the Smart-M3 progress is named SEPA (SPARQL Event Processing Architecture). Employing SEPA as a mean for semantic interoperability in the Web of Things means allowing heterogeneous devices to be discovered, accessed, and controlled through a set of SPARQL queries, subscriptions, and updates according to a given ontology. In this chapter, an ontology for the (Semantic) Web of Things is presented. Using web standards solves the issues of interoperability but poses new challenges with respect to the typical constraints of IoT applications.

INTRODUCTION
The Web of Things (WoT) is a very recent research area that tries to face the challenges to interoperability posed by the Internet of Things (IoT) through the use of Web Standards (Guinard and Trifa, 2016). Semantic Web of Things (SWoT), is instead the name of the research area investigating the use of Semantic Web technologies in the IoT to face this challenge (Jara et al., 2014). In this Chapter we discuss about the evolution of the Smart-M3...
Evolution of the Smart Spaces Paradigm Toward the Semantic Web of Things

platform (Viola et al., 2016) towards the new scenarios of the WoT and SWoT. The main pillar guiding our research is the ability to seamlessly discover and interact with (physical or virtual) devices, from now on Web Things, despite their heterogeneity. According to (Charpenay, Käbisch, and Kosch, 2016), we will then rely on a Thing Description to state the properties, actions and events exposed by a Web Thing and to solve the problem of discoverability (Guinard and Trifa, 2016) (i.e., discovering new devices in a network).

The Semantic Web of Things, as well as the Internet of Things, should support many different application domains, with very different characteristics. Among these requirements, it is worth mentioning the scaleability, the interoperability and the timeliness of messages. Scaleability is essential to permit the seamless growth of an application in terms of devices taking part in a Smart Space as well as in terms of data exchanged by the involved entities without a noticeable degradation of performance. Interoperability at information level is an essential requirement in scenarios that are intrinsically heterogeneous being them developed by different vendors and supporting different protocols. Lastly, SWoT/IoT applications usually require that new data is notified as soon as possible to the interested entities (e.g., let’s consider for example Vehicular Ad-hoc NETworks, also known as VANETs). The Smart-M3 platform (Viola et al., 2016) provides an environment for the development of reactive interoperable applications. Started in 2006 from NOKIA, the development of the Smart-M3 project is now carried on by several Universities in Europe (mainly in Italy, Russia and Finland). Smart-M3 has been successfully employed in vast European Projects like Internet of Energy (Bedogni et al., 2013), Chiron (Vergari et al., 2011), Recocape (Hamza et al., 2014), Arrowhead (D’Elia et al., 2015), and demonstrated its validity and maturity over a wide spread of application domains. Smart-M3 could then represent an ideal building block for the Semantic Web of Things. Nevertheless, a set of requirements should be met. This is the purpose of the latest evolution of the Smart-M3 platform, named SPARQL Event Processing Architecture (SEPA) (Roffia et al., 2018).

The development of the SEPA platform has started in 2016 with the aim of producing a reactive and reliable infrastructure for big data environments, like the Semantic Web of Things. SEPA supports W3C standards for the communication with a SPARQL Endpoint and provides, as also Smart-M3 does, a publish-subscribe interface that is now based on another standard protocol, Websockets (standardized by IETF as RFC 6455). Moreover, SEPA
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