From Heterogeneous Sensor Networks to Integrated Software Services: Design and Implementation of a Semantic Architecture for the Internet of Things at ARCES@UNIBO

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Abstract— The Internet of Things (IoTs) is growing fast both in terms of number of devices connected and of complexity of deployments and applications. Several research studies analyzing the economical impact of the IoT worldwide identify the interoperability as one of the main boosting factor for its growth, thanks to the possibility to unlock novel commercial opportunities derived from the integration of heterogeneous systems which are currently not interconnected. However, at present, interoperability constitutes a relevant practical issue on any IoT deployments that is composed of sensor platforms mapped on different wireless technologies, network protocols or data formats. The paper addresses such issue, and investigates how to achieve effective data interoperability and data reuse on complex IoT deployments, where multiple users/applications need to consume sensor data produced by heterogeneous sensor networks. We propose a generic three-tier IoT architecture, which decouples the sensor data producers from the sensor data consumers, thanks to the intermediation of a semantic broker which is in charge of translating the sensor data into a shared ontology, and of providing publish-subscribe facilities to the producers/consumers. Then, we describe the real-world implementation of such architecture devised at the Advanced Research Center on Electronic System (ARCES) of the University of Bologna. The actual system collects the data produced by three different sensor networks, integrates them through a SPARQL Event Processing Architecture (SEPA), and supports two frontend applications for the data access, i.e., a web dashboard and an Amazon Alexa voice service.

(5)