A Web Services based Approach for Resource-Constrained Wireless Sensor Networks

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Abstract

The large diffusion of Wireless Sensor Networks (WSNs) in our contemporary life with their numerous applications has led to a huge heterogeneity. This heterogeneity makes the possibility of discovering and collecting data from the wireless sensors more and more difficult. Indeed, WSNs are currently developed around different communities of sensor and user types, with each community typically relying on its own system, metadata semantics, data format and software. Therefore, the ability to discover and utilize a new sensor asset is typically hindered by incompatible services and encodings which can cause interoperability between different sensor nodes within the same WSN. Service-Oriented-Architecture (SOA) is one of the key paradigms that enables the deployment of services at large-scale over the Internet domain and its integration with WSNs could open new pathways for novel applications and research. Despite the need to integrate SOA with WSNs, only handful efforts are underway to achieve the goal. In this paper, we tackle integration of SOA with WSNs by proposing a Lightweight Representational State Transfer (REST)-based Web Services approach to treat sensors in an interoperable, platform-independent and uniform way.

Keywords: *Wireless Sensor Networks, Service-Oriented Architecture, REST.*

1. Introduction

Sensor technology is continuously improving as the devices become smaller, cheaper, more intelligent, and more power efficient. In consequence, more and more application fields are making use of these technologies [1, 2]. The increasing complexity of device networks consisting of up to thousands of devices is demanding new technologies for simple device interaction and interoperability.

Indeed, sensor networks are currently developed around different communities of sensor types and user types, with each community typically relying on its own stovepipe system for discovery, accessing observations, receiving alerts, and tasking sensor systems and models. Even within fairly coherent communities, each type of sensor tends to be accompanied by its on metadata semantics, its own data formats, and its own software. Thus the ability to discover and utilize a new sensor asset is typically hindered by incompatible encodings and services. There are a number of scenarios which can be presented as test cases for the need of interoperability, for example, a smart home with a set of services like security, energy management, assisted living, etc. A home in this case would have intrusion sensors on doors and windows, smoke sensors in rooms, temperature and light sensors for temperature control and may be fire sensors connected to fire station. Traditionally, each sensor shall be running only one application restricting the generic extensibility of the infrastructure. If we could access all these sensors (and applications) through a common interface, not only we can continue to run the existing applications, but we can also create and run more applications using the same resources.

The necessity, therefore, arises to espouse an interoperability architecture that is open and extensible, and allows for dynamic integration of services. The enabling of an open and extensible architecture requires interoperability at network as well as at application levels. The application layer interoperability poses bigger challenges. Different types of sensors are available, which generate sensor-specific data. The application developer must understand and analyze the message types and parameters used in the sensor nodes. One solution is to adopt a common specification, for all the sensing devices. This approach may work for a small set of devices, but is highly impractical. An alternative approach is to tailor, trim and use existing standard services in a light-weight fashion. SOA is a promising candidate middleware platform that closes this interoperability gap and mediates data exchange between heterogonous sensor platforms and Web applications and services in a unified way. SOA possesses an architectural style encompassing a set of services for building complex systems from existing