Chapter 2.7
A Platform for Pervasive Building Monitoring Services Using Wireless Sensor Networks

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ABSTRACT

At the core of pervasive computing model, small, low cost, robust, distributed, and networked processing devices are placed, which are thoroughly integrated into everyday objects and activities. Wireless Sensor Networks (WSNs) have emerged as pervasive computing technology enablers in several field, including environmental monitoring and control. Using this technology as a pervasive computing approach, researchers have been trying to persuade people to be more aware of their environment and energy usage in the course of their every day life. WSNs have brought significant benefits as far as monitoring is concerned, since they are more efficient and flexible compared to wired sensor solutions. In this chapter, the authors propose a Service Oriented Architecture for developing an enterprise networking environment used for integrating enterprise level applications and building management systems with other operational enterprise services and functions for the information sharing and monitoring, controlling, and managing the enterprise environment. The WSN is viewed as an information service provider not only to building management systems but also to wider applications in the enterprise infrastructure. The authors also provide specification, implementation, and deployments of the proposed architecture and discuss the related tests, experimentations, and evaluations of the architecture.

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INTRODUCTION

Accurate monitoring of the buildings, systems and their surroundings has normally been performed by sensors dispersed throughout the buildings. Existing building systems are tightly coupled with the sensors they utilize, restricting extensibility of their overall operation. The emergence of Wireless Sensor Networks (WSNs) has brought significant benefits as far as environmental monitoring is concerned, since they are more efficient due to the lack of wired installations compared to their wired counterparts, while additionally they allow for flexible positioning of the sensor devices. Pervasive computing environments such as intelligent buildings require a mechanism to easily integrate, manage and use heterogeneous building services and systems including sensors and actuators. Any WSN system, viewed as a system offering a building service, should be designed in such a manner, so as to allow its straightforward integration to the general networking infrastructure where any other applications can utilize the data gathered by the WSN.

Achieving this integration necessitates an overall building services framework architecture that will be open and extensible, allowing for dynamic integration of updated or advanced building services addressing the diversity of the offered building services and the scalability issues related to any specific building applications.

The most prominent approach towards realizing the above goal is that of Service Oriented Architectures (SOAs) open framework (Erl, 2005). In the case of SOAs all architectural elements are decoupled and considered as service providers and consumers. Service discovery and access to the services is performed in a dynamic manner, ensuring a generic and extensible design. Web Services (Stal, 2002) constitute the most significant technological enabler of SOAs due to the interoperability that they offer and the fact that they can easily support the integration of existing systems.

SOAs are essentially a means of developing distributed systems, where the participating components of those systems are exposed as services. A service can be defined (Sommerville, 2007, p. 747) as "a loosely coupled, reusable software component that encapsulates discrete functionality, which may be distributed and programmatically accessed." The motivation for constructing a SOA is to enable new, existing, and legacy pieces of software functionality to be put together in an ad-hoc manner to rapidly orchestrate new applications in previously unpredicted ways to solve new problems. This can result in highly adaptive enterprise applications (Malatras, 2008a).

The usage of SOA is as follows. The service provider registers the offered services to a service registry, which is accessed by a service consumer that wishes to interact with a service that satisfies certain requirements. The service registry informs the service consumer on how to access a service that satisfies its selection criteria, by returning the location of an appropriate service provider. The service provider and consumer from that point onwards exchange messages in order to agree upon the semantics and the service description that they are going to be using. The service provisioning subsequently takes place, with the consumer possibly expecting some response from the provider at the completion of the process.

The SOA architecture is broken down into a set of enterprise middleware services, a set of application services and a service bus. These are described in details in (Malatras et al., 2008a). This architecture is generic enough allowing for different types of applications to be integrated, provided they are capable of exposing appropriate services on the service bus. Characteristic examples of applications include security systems, business and operational functions, ambient user interfaces to display building related information, Wireless Sensor Networks (WSNs) to monitor and collect building-related information, and services offered by building management systems and building assessment tools, etc.