# Chapter 16
# Smart Rooms:
## A Framework for Inferencing Using Semantic Web Technology in Ambient Intelligent Network

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## ABSTRACT

*In this chapter, the authors present a framework to provide useful and accurate information to users based on data collected from rooms in a building comprised of wireless sensor networks. The authors call a room "smart room" when a room is considered suitable for a particular purpose. For instance, a dark room for a conference, a bright room for a party, et cetera, which can be determined according to the data available from various positions of sensors located in each room and a sensor network of a building. The authors undertook the task of designing a semantic inferencing framework for a smart room. This led to automatic extraction of information from the central repository or even when the data is in a transient state (dynamic) in the network. The chapter discusses a practical way of building a query system using semantic Web technology and tools. Similar systems are becoming more feasible nowadays, and industrial leaders are moving forward to build them from commercial view point. The chapter is concluded with some future directions of the system.*

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## INTRODUCTION

Semantic web technologies are getting more attractions due to the large number of open sourced tools available nowadays. Big vendors like Google, Microsoft, Yahoo have started to consider using this technology in their products to better produce query results for end users. Semantic web technology has huge applicability in information retrieval systems, decision support systems and recommender systems. The main advantages of using the technology is to make the software agents to understand the problem/domain space based on some facts from semi-structured/structured data and thus extract some new facts with the power of inferencing. Thus, it helps to reduce work load of human being which is practically very time consuming or sometimes impossible.

Wireless Sensor Networks (WSN) have become more prevalent in both the industrial and commercial market. The reason for this prevalence is due to various factors which include miniaturization of electronic components, better transport layer protocols and low energy access protocols. A lot of the success is also contributed towards the open source Operating System, called TinyOS (Satyanarayanan, 2002), that sensors have installed on them. Such networks are used for remote environment monitoring, surveillance, industrial automation, civil and structural analysis (Remagnino & Forest, 2005). These networks are designed to be integrated in the human surroundings in such a way that they are un-noticeable. Additionally, the number of sensors present in a target environment can exceed 1000 sensors easily as they can be placed anywhere and hence, give the overall environment the characteristic of any-where-any-time information. The data from all these sensors is received by a central gateway and then processed for information on the basis of which reactions might occur. For example, the temperature of a room can be constantly monitored through temperature sensors throughout the room and on the basis of this data decisions can be made in how to control the HVAC system for the room. It can be seen that WSN inherently generate a large amount of data which has to be stored at a central repository. In order to make efficient and quick use of this data, Semantic Web techniques can be used to enable machines/computers to "understand" the data. This can lead to the automatic extraction of information from the central repository or even when the data is in a transient state in the network.

This chapter describes a framework for Semantic Inferencing that we proposed. It also gives an overview of the various tools that we have used to automate the process of the creation of our framework. The next section of the chapter describes the steps involved in this process. The section following that describes the 'sensor network ontology' which is considered as the backbone of this framework. The data mapping mechanism (i.e. data that are collected from sensor networks) for the ontology to create a knowledge base is presented in the fourth section. The section after that describes the transformation of fact and rules in RuleML and the inferencing process with some sample queries. Finally, we discussed on some of our future works.

## SMART ROOM FRAMEWORK

The steps to create a framework and tools used are given below (see also Figure 1).

1. The very first part of the framework is the creation of Ontology. In this part the concepts used in our application are defined and arranged in a conceptual hierarchy. The Ontology creation was done by a tool from Altova called *SemanticWorks*.
2. This second part was the instance document creation. In other words, ontology has to be populated with data which are called here as instances. So, once the Ontology is available, the next step is to create an instance