Chapter 2.3
Design of SOA Based Framework for Collaborative Cloud Computing in Wireless Sensor Networks

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ABSTRACT

WSN deployments are growing at a fast rate; however, current WSN architectures and setup do not promote the sharing of data on an inter-WSN basis. Cloud computing has emerged as a promising area to deal with participatory and collaborative data and services, and is envisaged that collaborative cloud computing WSN could be a viable solution for sharing data and services for WSN applications. In this paper, SOA based architecture has been proposed to support collaborating cloud computing in WSN. The architecture consists of layered service stack that has management, information, presentation and communication layers with all required services and repositories. Interactions between WSN, subscribers and other cloud are also presented as sequence diagrams. The proposed framework serves the cloud subscribers with wide range of queries on the data of multiple WSNs through suitable interface to solve large scale problems.

INTRODUCTION

The technology of wireless sensor networks has completed a decade or so. In these years researchers, deployers, application programmers have put tremendous efforts to make these new technologies reach to the beneficiaries. The benefits of sensor networks are well realized and many deployments are taking place to study the serious problems of environmental monitoring, habitat monitoring, healthcare, production system, inventory management etc. However, for the solutions to some gross problems like global warming or pollution

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etc. we need to collect, understand the data as well as its patterns in totality and wide scale. This will not be possible unless diverse physical WSN collaborate. The cloud computing comes as a possible answer to the problem. To achieve this task there is an urgent need to rethink about the present architectures orientation and seclusion of wireless networks. Further, there is a need to change the perception of WSN organisation.

Our earlier work described in this paper, prepared the background in the direction of this new structure. In this paper the problem pertaining to the current state of WSNs architecture is identified, the need of new architecture supporting cloud computing on WSN is emphasized and a solution comprising of a framework having Service stack divided in four major layers, each layer supporting various services and repositories, is proposed. Functioning of the architecture and interaction sequences between major players like WSN, Subscribers and Other clouds are also described. The new architecture uses the features of cloud like virtualisation and Service oriented architecture to deal with heterogeneity.

The paper is structured as follows: related work on various architectures that focus on data sharing and limited WSN collaboration and limitations of current WSN architectures are presented. The path toward collaborative model is also introduced. The model with service stack for WSN cloud is described and the need of SOA approach for achieving heterogeneity is stated. The functioning of WSN cloud is also shown. Finally the need of WSN cloud to solve the global problem is emphasized.

RELATED WORK

Looking to the scenario of research in the area of cloud computing pertaining to sensor networks we don't find much published work. However there has been an effort depicting architectures which employ grid-based or publish subscribe models to achieve efficiency, availability, scalability and collaboration to some extent for the present and future wireless sensor networks deployments. OGC open Geospatial consortium (Botts, Percivall, Reed, & Davidson, 2006) is engaged in promoting the agile Sensor Web Enablement for the wireless sensor networks. It has developed XML schemas for configuring a WSN ready to serve on web. It also presents connectivity architecture to deliver the sensor data. Chen Khong et al (Tham & Buyya, 2005) present a report on sensor grid network to deal with the processing of the data and application logic by putting them into a grid based architecture. Mark Gaynor et al show how to integrate WSNs with a grid (Gaynor, Moulton, Welsh, LaCombe, Rowan, & Wynne, 2004). Geoffrey et al has worked on the Collaborative Sensor Grid framework (Fox, Ho, Wang, Chu, & Kwan, 2008) which presents the design to increase the efficiency of data delivery and how one grid can collaborate with the other grid. The problem with grid based architecture is that that the designers concentrate on achieving efficiency in the processing by clustering the HPC based machines. The scalability, availability, collaborative ness and homogeneity are not the prime goals. Looking to the various solutions for wireless sensor networks, the most common thing which is observed is, even in the collaborative, distributed and grid based approach, they cater the need of their own organisation. John Douglas et al present an open distributed architecture for environmental risk management (Douglas, Uslander, Schimak, Esteban, & Denzer, 2008) in which they use two architectures ORCHESTRA and SANY. However it doesn't indicate how to search for independent secluded networks, which are the part of other organisation. Mires (Souto et al., 2005) is a publish/subscribe architecture for WSNs in which the sensors publish the sensed data at the cluster heads and finally to the sink node which give the data to the subscriber. The TinySIP (Krishnamurthy, 2006) architecture uses publish/subscribe and instant messaging model in which