Chapter 13
Self-Healing and Green Energy in Wireless Sensor Network: A Survey

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ABSTRACT

Green energy can be classified into many domains such as green aware applications, green aware protocols, green energy harvesting, and many more. The main focus of this chapter is to analyze green energy in terms of energy aware routing protocols and mainly focusing on wireless sensor networks. So, in this domain, greening the routing protocols with energy efficient algorithms is investigated. Energy efficient routing algorithms can be designed by having self-healing concepts whereby routing algorithms can heal themselves when a routing hole is found or nodes can heal themselves when energy depletion occurs. Having that concept in mind, this chapter investigates both the green energy protocols and the self-healing protocols in the literature.

INTRODUCTION

Wireless sensor networks are created for monitoring situation such as temperature, sound, movement, location, to create "smart environments". (Youssef et al. 2002 & Noor Zaman et al. 2010-2011). Sensor network has its distinct features from traditional network by having limited energy resources (Noor Zaman et al. 2012). Most of the routing in wireless sensor is done through lowest energy route this eventually

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exhausts energy at these nodes impacts the lifetime of the entire network. (Sha et al. 2005 & Noor Zaman et al. 2012). Energy efficient routing becomes the prime importance when considering extending the lifetime of sensor network. (Gui & Mohapatra 2003 & Noor Zaman et al. 2011). When sensor nodes exhaust their energy indefinitely, the nodes will eventually create a routing hole (Zaman N et al. 2014). Routing hole refers to the areas where data cannot be routed since there are no active nodes available (Zaman N et al. 2015). Therefore a self-healing mechanism is needed to detect this issue. So the technique of fighting routing holes in sensor network is denoted as self-healing methods. Therefore the two prominent features in wireless sensor network that need attention in research are energy-efficiency and self-healing. This paper targets to carry out an evaluation of several energy efficient and self-healing routing protocols in wireless sensor networks. This paper differs from other studies, as it performs a study on bio-inspired as well as non-bio inspired mechanisms for energy efficient routing protocols that have been submitted by others given the advantages and disadvantages of each proposed protocol. The paper is organized as follows: section 1 will look at some of the literature reviews based on the terms such as self-healing and energy efficiency. The literature starts by looking at what is meant by autonomic computing in which self-healing is one of the aspects of it. Further literature looks at what is meant by energy efficient routing in wireless sensor network. Section 2 consists of surveys on various energy efficient self-healing routing protocols discussing their protocol approach and results. Section 3 further gives a summary of each protocol giving a brief summary on its advantages and disadvantages. A complete comparison using various metrics is given at section 4. Section 5 concludes the paper with recommendation and future research issues.

Autonomic Behavior in Wireless Sensor Networks

Autonomic system is considered as a system that is capable of self-management services. Self-management activities can be categorized into self-healing, self-optimization, self-configuration, self-protection, self-awareness, self-knowledge, self-maintenance and self-service (Lanthaler,2000). According to Lanthaler (2000), there are four important tasks that an autonomic sensor node should perform for self-healing purpose. The functions are: i) to monitor and to collect data from the system, ii) to analyze whether something is going wrong in the system, iii) to plan or to create desired changes in order to execute the changes and iv) to perform the desired actions (Figure 1).

Self-Healing Behavior in Wireless Sensor Networks

Self-healing in the context of wireless sensor network is the capability of sensor network to recover from any types of behavior such as malicious attack, disruption or failure. In terms of failure, there exist two natures of failure: the failure of node and the failure of system. Failure in sensor network is due to many reasons such as failure in software and failure in hardware; unavailability of communication link, medium access contention and failure in routing. This failure in WSN is considered one of the main challenges and yet opens to many areas of research and discussions. Routing failure occurs due to routing holes, node failure, energy depletion, natural disruption in sensor area and many more. Self-healing in the context of routing failure is the capability of sensor nodes to monitor, detect, analyze, plan and execute events in order to recover or heal from the phenomena (Lanthaler,2000). Moreover, self-healing by means of energy efficient routing is one of the main research focuses. There are various research projects going on that trying to tackle the self-healing problem in the context of software systems. The model proposed

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