Chapter I

INTRODUCTION

This thesis provides an introduction to wireless sensor network [47-51], their history and potential, previous deployments and engineering issues that concern them, and the security challenges that will have to be overcome before WSNs can be widely deployed. The major contributions of this research work are a) A new key pre-distribution and energy efficient routing protocol to WSNs that address their security concern. b) Assessing the use of asymmetric key [16] generation in general and that of hybrid routing approaches that can discover the secured link, increase the energy efficiency, increase the number of alive nodes and extend the network life time of WSN through the use of the Cluster Head Selection Algorithm to deliver data in a WSN.

First motivation to work in this research area is the existence of key pre-distribution algorithm [13] in sensor network. Eschenauer and Gligor [32] was the first to address a probabilistic solution to this problem. Then Camtepe and Yener [19], Lee and Stinson [17] and many others proposed deterministic solution to this problem with the help of design theory. Ruj and Roy [6] was the first to provide a solution using Reed- Solomon code. Having successfully developed a novel key distribution algorithm in this research, the immediate motivation was to check this novel key distribution algorithm with other coding techniques having key distribution component in order to assess the resiliency of the novel coding algorithm.

Second motivation is the Energy efficiency techniques which play a significant role in saving the energy. In general algorithm a node becomes a cluster-head by a stochastic mechanism of tossing biased coins. Hence non cluster-head nodes belonging to the hot regions,
which are expected to transmit frequently, dissipate more energy in transmitting data to a remote cluster-head located far. This leads to uneven energy dissipation over the network thereby reducing the network lifetime. Also it assumes that every time a node becomes a cluster-head, it dissipates an equal amount of energy. This is incorrect, as cluster-heads located far from the base station spend more energy in transmitting data than those nodes located near the base station. Thus, this research work has contributed an extended stochastic cluster head selection algorithm for network having spatio-temporal variations in data reporting rates across different region.

1.1 Scope

The first goal of the research work discussed in this thesis is to explore the performance of novel key pre-distribution schemes for increasing the resiliency of the network. Asymmetric based key distribution schemes are introduced and analysed. The resiliency of the network is analysed by deploying sensor nodes in a square region and pre-assigning keys to each sensor nodes for creating a link between nodes to transfer data. It presents the simulation results which demonstrate the number of compromised nodes in a network when some of the nodes in the network are captured by an attacker. The thesis describes these protocols for improving security in the sensor network. The second goal is to explore energy efficiency clustering approaches which increases the energy efficiency of the network. The sensor nodes are used to collect and report application-specific data to the sensor node, known as a sink node. Hierarchical routing protocols are best known for their energy efficiency. By using a clustering technique hierarchical routing protocol greatly minimize the energy consumed in collecting and distributing the data. The proposed protocol focuses on reducing the energy consumption and increasing the network life time of wireless sensor network.
1.2 Layout of Thesis

This section illustrates how best the thesis should be read. Figure 1.1, gives the structure of the core chapters of the thesis, illustrating any structural dependencies between its different chapters. Material from earlier chapters will be required in order to fully comprehend these chapters.

![Diagram of Thesis Structure]

Figure 1.1 Structure of Thesis
Chapter II

Chapter II provides a general overview of Wireless Sensor Network (WSN), and introduces the main engineering challenges faced by WSN, such as the importance of energy efficiency, and the potential performance improvement needed for key pre-distribution protocols by analysing the previous sensor node platforms and deployments, and considering the essential characteristics that separate previous example deployments from typical research cases. This chapter explains the motivations which were instrumental in carrying out the work performed in this research work and reported in this thesis.

Chapter III

Chapter III presents a literature review which investigates in detail the security challenges facing wireless sensor network. It presents motivations for potential attack in different application scenarios. It defines essential fundamental properties of security in a system, together with the specific challenges for security engineering in WSNs. For example, given the energy limitations under which conventional WSNs operate, any individual device introduced by an attacker can often access resources beyond the capabilities of an individual node. It then presents taxonomy of common attacks within WSNs, and approaches that the literature has employed to mitigate them. The shortcomings and drawbacks of these approaches for realistic WSN deployments are used to motivate the work in the forthcoming chapters.

Chapter IV and V

Chapter IV and V explores a methodology to design protocols and implement practical WSN systems, and motivates simulation as important for the development of new network protocols, resulting from the high costs of deployments and the need for a consistent environment for testing. The simulation environments and specific software used for the
production of results within the thesis are analysed and motivated. The chapter then presents energy efficiency clustering and key distribution models that will be presented throughout the thesis in order to perform security over the network.

Chapter VI

In Chapter VI a model to discuss proposed energy efficient routing problem and key distribution scheme for wireless sensor network are established. The mechanism by which a routing policy would control the energy is studied which is a very critical and greatly restricted resource in wireless sensor network. A mathematical model to deal with the energy efficient routing problem in order to maximize the network life time, increase the energy efficient and increase the alive nodes base on the cluster head selection algorithm in the system is developed.

Chapter VII and Chapter VIII

The simulated output of energy efficiency and key predistribution scheme was discussed in these chapters. The results were compared with the existing other protocols and proves that the proposed method is best.

Chapter IX

Chapter IX concludes the thesis and provides a summary of the issues involved in security engineering, particularly within the energy-constrained domain of WSNs. The criteria for deployment of the particular schemes developed in the thesis are considered. The novel contributions contained within the thesis are summarised and their context within the literature is explained.

Summary: This chapter discussed the snapshot view of the research work done as part of this Ph.D. work with chapter wise distribution of work details.