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Energy Efficient Multipath Secure Routing for Wireless Sensor Networks

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Abstract
Aim of project is to develop a novel probability model to analyze best redundancy level In terms of path redundancy, source redundancy and best IDs. The contribution of project is to decide "how many paths to use and which path to use" in order to tolerate residual compromised node that survive our IDs to increase the life time of diverse wireless sensor networks. This is especially a critical issue in military or mission-critical WSN applications. Sensor nodes (SNs) close to the base station (BS) are more critical in gathering and routing sensing data. In the literature, various schemes have been designed for preserving critical SNs from energy exhaustion so as to prolong the system lifetime maximization; however, how to counter selective capture. We propose and analyze an adaptive network management algorithm with 3 countermeasures to counter selective capture: (1) optimal communication range and mode adjustment; (2) intra-clustering scheduling and inter-cluster multihop routing scheme; and (3) voting based intrusion detection. We develop a probability model to reveal the tradeoff between energy consumption vs. reliability and security gain with the goal to maximize the lifetime of a query-based WSN.

Keywords: heterogeneous wireless sensor networks, selective capture multipath Routing, lifetime maximization, intrusion detection, reliability, security, energy Conservation

1. Introduction

The problem of energy efficient reliable routing in wireless networks with unreliable communication links or devices or lossy wireless link layers by merging the power control schemes into the energy efficient routing is main goal of project. This work majorly focuses on the problem of energy-efficient reliable wireless communication in the presence of unreliable or loss wireless link layers in multi-hop wireless networks. Energy-Efficient and Reliable Routing (E2R2) is used for networks in which either hop-by-hop or end-to-end retransmissions ensure reliability. In wireless sensor networks, because of unreliable wireless media, host mobility and lack of infrastructure, providing secure communications is bit difficult in this type of network environment. In present work to ensure the security in unreliable wireless communication the cluster based topology technique is used, to obtain confidentiality and authentication of nodes hash function and MAC (Message Authentication Code) techniques are used.

Many wireless sensor networks (WSNs) are deployed in neglected environment in which energy replenishment is difficult but not impossible. Due to limited resources, a WSN should satisfy the application specific QoS requirements such as reliability, timeliness and security, but also minimize energy consumption to continuous usage of system lifetime. The tradeoffs between energy consumption Vs reliability gain with the goal to maximize the WSN system lifetime. A critical issue in military, business WSN applications. Sensor nodes (SNs) close to the base station (BS) are more critical in gathering and routing sensing data. In the literature, various schemes have been designed for preserving critical SNs from energy exhaustion so as to prolong the system lifetime; however, how to counter selective capture. We consider this optimization problem for the case in which a voting based distributed intrusion detection algorithm is applied to remove malicious nodes from the HWSN. Our contribution is a modelbased analysis methodology by which the optimal multipath redundancy levels and intrusion detection settings may be identified for satisfying application QoS requirements while maximizing the lifetime of HWSNs. We analyze the optimal amount of redundancy for multipath routing and the best intrusion detection settings for detection strength under which the lifetime of a query-based WSN is maximized in the presence of selective capture.

II Literature Survey

G. Kalpana [1] this paper, WSN has gained wide popularity and have gone up tremendously in recent time due to increase in Micro-Electro-Mechanical Systems (MEMS) technology. WSN has to connect the virtual world with the physical world by forming a network of sensor nodes. In cluster-based routing, some special nodes that are called cluster heads form a wireless base station to the sink which collect data from sensor and forward it to base station. Energy saving in these approaches can be obtained by formation of cluster, electing cluster-head, data aggregation at the cluster-head nodes to data redundancy reduction and thus save energy. Due to the scarce energy resources of sensors, one of the main problems in the design of routing protocols for WSNs is energy efficiency. Therefore, routing protocols designed for WSNs should be as highly energy efficient to increase the lifetime of individual sensors, and also the network lifetime. We have studied a routing protocol and we got queries and databases using sensor nodes and interaction with the location-based routing protocol are generally open issues for further research. Future research issues should focus on more security, better QoS and high node mobility. Routing techniques for WSNs should address application security issues such as reliability, authentication, confidentiality etc. Mohammad Masdari [2] in this paper, Multipath routing protocols improve the general load balancing and high quality of service in WSN and also generate reliable communication in network. This checks various multi-path routing protocols of the WSN in the literature and displays its benefits. The main elements of these techniques and classifications are based on their attributes which have been discussed in paper. Multipath routing is one of the efficient methods to improve the network capacity and productivity of resources under hefty traffic conditions. It presented a analysis of multipath routing protocols in wireless sensor networks. The authors also specified the problems related to implementing multipath routing protocols in WSN and compare various properties of routing protocols. The comparison is of great importance to understand the previous solutions and also design new multipath routing protocols. K. Vinoth Kumar [3] this paper work aims at implementing a multi-hop energy effective, fault tolerant and reliable routing protocol. It presents to maintain an network of sensors so that the nodes get a chance to generate their transmission ranges best, and thus delivery of data to the base station. This protocol concentrates on the feature of load sharing by maintaining multiple routes and selecting the best one for forwarding the data packets. The problem around the sink is managed by changing the transmission ranges of the nodes timely, which changes the topology, to balance the availability among the nodes in the network. The focus was towards constant distribution of data transmission and dissemination of load among the nodes in the network. We surveyed the specification of motes and concluded that by adjusting per-node transmission power, it is possible to control topology and thus eliminate the bottleneck of the base station. It results in increasing of lifetime of the network. Ning Sun [4] in this paper, Energy awareness is used to design a reliable routing protocol for wireless sensor networks (WSNs) due to the limited capability of the nodes. Reliability has a more important issue in WSNs, since the nodes are fear to fail and the networks are highly unstable. The proposed Energy Efficient and Reliable Routing Protocol (E2R2P) use clustering to effectively decrease the amount of data transmissions between nodes and the sink (BS). Furthermore, our protocol allows cluster heads (CHs) transmit data to the sink along multiple paths, so that it improves the reliability of transmission even if some paths are in failure, in the same time reduce the consumption of energy of the complete network. E2R2P uses probability algorithm to generate network into clusters, which reduces the number of messages that are required to be delivered in the network. Furthermore, algorithms of cluster head rotation and multipath discovery are implemented to evenly distribute energy among all the nodes. Both of the process of cluster formation and multiple path discovery are in form of distribute, it provides guarantee to scalability of the network. The methods in turn result in load balance and fault tolerance, finally increased network lifetime. Ali Norouzi1 [5] in this paper, WSNs are deployed in several applications; energy usage is the determining factor in the performance of WSN. Consequently, methods of data routing and transferring to the sinks are very important because the sensor nodes run on battery power and the energy available for sensors is quite limited. We intend to propose a new protocol called Fair Efficient Location-based Gossiping (FE Gossip-ing) to focus the problems. Saving the nodes energy leads to an increase in the node lifetime in the network, in comparison with the other routing protocols. Furthermore, the protocol reduces navigation delay and loss of packets. Hence we studied the operation of a routing protocol with safe energy consumption, and discussed the factors of energy optimization. And we find the ways in which we choose the next hop, the network lifetime can be increased. As a result, we have extended the network lifetime, an increased packet delivery ratio, reduced the message overheads and the energy consumed by the nodes is reduced. In Wireless Networks" we propose a new routing protocol that optimizes energy consumption and bandwidth. Using less energy in routing protocols reduce overhead. Satvir Singh [6] in this paper, an energy efficient routing is a important issue in the implementing of Wireless Sensor Network (WSN) protocols. It presents a comprehensive survey on energy efficient routing protocols in WSNs. From the protocols, it is clearly seen so far that, the performance of protocols is worth better in terms of energy efficiency. There is very little research done in improving better QoS parameters in a very energy sensor networks. The sink node and sensor node are mostly constant thus research can be done by assuming sink and source node as mobile Various topologies, routing algorithms can be used based on the different application of WSN. Results can be improved using multiple sink nodes. Monica R Mundada [7] in this paper, WSN consists of low cost, low power, small in size and multi-operational sensor nodes. Routing protocols in WSNs emphasize on data, limited battery power and bandwidth in order to facilitate efficient working of the network, thereby increasing the lifetime of the network. WSN has a design trade-off between energy and communication overhead which makes the nerve center of the all routing techniques. It presents a survey of routing techniques in WSNs under all the three categories. We epitomize these routing techniques and bring out the advantages and drawbacks followed by their domain. We classify the routing protocols in WSNs into data centric, hierarchical and geo location based depending on the network infrastructure. The radio range and the transmission power of both CHs and SNs are dynamically adjusted throughout the system lifetime to maintain the connectivity between CHs and between SNs. Any communication between two nodes with a distance greater than single hop radio range between them would require multi hop routing. Due to limited energy, a packet is sent hop by hop without using acknowledgment or retransmission [2]. All sensors are subject to capture attacks, i.e., they are vulnerable to physical capture by the adversary after which their code is compromised and they become inside attackers. Since all sensors are randomly located in the operational area, the same capture rate applies to both CHs and SNs, and, as a result, the compromised nodes are also randomly distributed in the operation area. Due to limited resources, we assume that when a node is compromised, it only performs two most energy conserving attacks, namely, bad-mouthing attacks (recommending a good node as a bad node and a bad node as a good node) when serving as a recommender, and packet dropping attacks. when performing packet routing to disrupt the operation of the network. Using homogeneous nodes which rotate among themselves in the roles of cluster heads (CHs) and sensor nodes (SNs) leveraging CH election protocols such as HEED [12] for lifetime maximization has been considered [2], [3]. In the optimal communication range and communication mode were derived to maximize the diverse WSN lifetime. In intra-cluster scheduling and inter-cluster multi-hop routing schemes to maximize the network lifetime. In [4], the authors considered a two-tier diverse WSN with the objective of maximizing network lifetime while fulfilling power management and coverage objectives. They determined the optimal density ratio of the two tier's nodes to maximize the system lifetime. Our work considers the presence of malicious nodes and explores the tradeoff between energy consumption vs. QoS gain in both security and reliability to maximize the system lifetime.

III. Proposed Work

Faith Based Neighbor Weighted Voting Scheme to strengthen intrusion detection in WSN is evaluate the dynamic radio range of neighbor nodes. Identification of multi source multipath routing for intrusion tolerance at higher levels. Neighbor Weighted Voting algorithm provides Faith weight of each neighbor sensor node. Weight threshold is evaluated for marking the sensor node as normal node and malicious node. Discard the communication of internal malicious node by identifying lower weight votes of corresponding sensor node. The best number of voters and the intrusion invocation interval used for intrusion detection under which the lifetime of a WSN is maximized in the presence of selective capture which turns nodes into malicious nodes capable of performing packet dropping attacks and bad-mouthing attacks. Wireless

Sensor Network WSN comprises sensors of different capabilities types of sensors are Cluster Heads (CHs) and Sensor Nodes (SNs).CHs are superior to SNs in energy and computational resources, denote the initial energy levels of CHs and SNs, and applied to any shape of the operational area

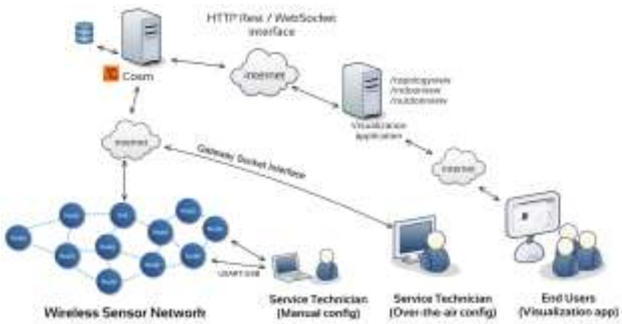
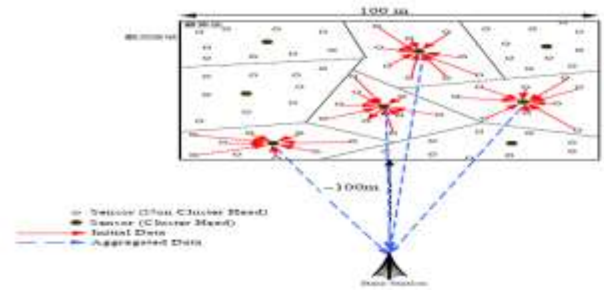


Fig. 1. Architecture of Wireless Sensor Network.

Actually combining sensors, radios, and CPU's into an effective wireless sensor network requires a detailed understanding of the both capabilities and limitations of each of the underlying hardware components, as well as a detailed understanding of modern networking technologies and distributed systems theory. Each individual node must be designed to provide the set of primitives necessary to synthesize the interconnected web that will emerge as they are deployed, while meeting strict requirements of size, cost and power consumption. A core challenge is to map the overall system requirements down to individual device capabilities, requirements and actions. To make the wireless sensor network vision a reality, architecture must be developed that synthesizes the envisioned applications out of the underlying hardware capabilities. To develop this system architecture we work from the high level application requirements down through the low-level hardware requirements. In this process we first attempt to understand the set of target applications. To limit the number of applications that we must consider, we focus on a set of application classes that we believe are representative of a large fraction of the potential usage scenarios. We use this set of application classes to explore the system-level requirements that are placed on the overall architecture. From these system-level requirements we can then drill down into the individual node-level requirements. Additionally, we must provide a detailed background into the capabilities of modern hardware. After we present the raw hardware capabilities, we present a basic wireless sensor node. A HWSN comprises sensors of different capabilities. We consider two types of sensors: CHs and SNs. CHs are superior to SNs in energy and computational resources. We use ECH init and ESN init to denote the initial energy levels of CHs and SNs, respectively. While our approach can be applied to any shape of the operational area, for analytical tractability, we assume that the deployment area of the HWSN is of size A2. CHs and SNs are distributed in the operational area. To ensure coverage, we assume that CHs and SNs are deployed randomly and distributed according to homogeneous spatial Poisson processes with intensities λCH and λSN, respectively, with λCH < λSN. The radio ranges used by CH and SN transmission is denoted by rCH and rSN, respectively. The radio range and the transmission power of both CHs and SNs are dynamically adjusted throughout the system lifetime to maintain the connectivity between CHs and between SNs. Any communication between two nodes with a distance greater than single hop radio range between them would require multihop routing. Due to limited energy, a packet is sent hop by hop without using acknowledgment or retransmission [2].



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V Methodology

E2R2 mainly guards a WSN against the attacks directing the multi-hop routing, especially those based on theft through replaying the routing information. This system does not address the denial-of-service (DoS) attacks, where an attacker intends to affect the network by using its resource. For instance, we do not address the DoS attack of congestion network by resending numerous packets or physically blocking the network. E2R2 aims to achieve the following desirable properties: High Packet delivery rate, Energy Efficiency, scalability and adaptability. However, link failure condition is also taking into consideration by E2R2. So, packet loss, time delay such things happen due to link failure should be consider when we want to achieve high throughput [1].

We develop a mathematical model to estimate the MTTF of a HWSN using multipath data forwarding for answering queries issued by a mobile user roaming in the HWSN area. The basic idea of our MTTF formulation is to we first deduce the maximum number of queries, *Nq*, the system can possible handle before running into energy exhaustion for the best case in which all queries are processed successfully. As the system dynamically evolved, the amount of energy spent per query also varies dynamically. *A. Network Dynamic:* Initially at deployment time all nodes (CHs or SNs) are good nodes. Assume that the capture time of a SN follows a distribution function *Fc*(*t*) which can be determined based on historical data and knowledge about the target application environment. *B. Query Success Probability:* We will use the notation *SNj* to refer to *SN j* and *CHj* to refer to *CHj*. There are three ways by which data forwarding from *CHj* to *CHk* could fail: (a) transmission speed violation; (b) sensor/channel failures; and (c) *CHj* is compromised. The first source of failure, transmission speed violation, accounts for query deadline violation.

Our example HWSN consists of 3000 SN nodes and 100 CH nodes, deployed in a square area of A2 (200m × 200m). Nodes are distributed in the area following a Poisson process with density λSN = 30 nodes/(20 × 20 m2) and λCH = 1 node/(20×20 m2) at deployment time. The radio ranges rSN and rCH are dynamically adjusted between 5m to 25m and 25m to 120m respectively to maintain network connectivity. The initial energy levels of SN and CH nodes are ESN 0 = 0.8 Joules and ECH 0 = 10 Joules so that thThe correctness of our protocol design is evidenced by the effect of Tcomp, m, and TIDS on optimal (mp,ms). show MTTF vs. (mp,ms) under low and high attack rates, respectively. First of all, in both graphs, we observe the existence of an optimal (mp,ms) value under which MTTF is maximized. Secondly, there exists an optimal m value (the number of voters) to maximize MTTF. In Fig. 10, m = 7 yields a higher MTTF value than m = 3 because in this scenario the attack rate is relatively high (one in four days), so a higher number of voters is needed to cope with and detect bad nodes more effectively, to result in a higher query success rate and thus a higher MTTF.ey exhaust energy at about the same time

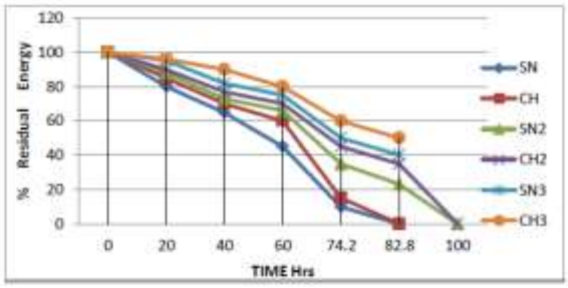

Fig :Effect of (*mp,ms*) on energy of CHs and SNs

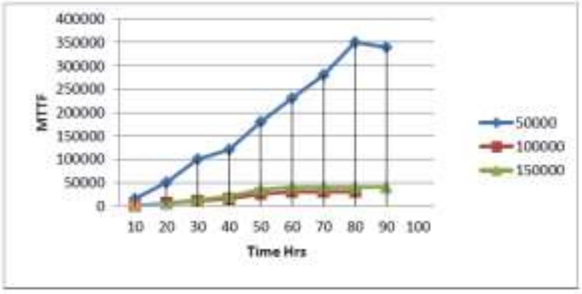

Fig:Effect of (m_p, m_s) on MTTF.

VI. Conclusion

The goal is to satisfy the application QoS requirements to continuous life time of sensor system. And to improve mathematical model for lifetime sensor systems by using two function system parameter such as source and path redundancy levels. The basic idea behind this is to reuse available system information which variety layer stack. Adaptive network management with three countermeasures for coping with selective captures aiming to create holes near the base station in a wireless sensor network to block data delivery. Our countermeasures are effective against selective capture.Radio adjustment, the best redundancy level for multipath routing, the best number of voters, and the best intrusion invocation interval used for intrusion detection to maximize the system lifetime. Our future work, we plan to explore more extensive diverse attacks in addition to packet dropping and bad mouthing attacks, each with different implications to energy, security and reliability, and investigate intrusion detection and multipath routing based tolerance protocols to react to these attacks. To strengthen intrusion detection through "weighted voting" leveraging knowledge of trust/reputation of neighbor nodes, And to tackle the "what paths to use" problem in multipath routing decision making for intrusion tolerance in WSNs. we plan to explore trust-based admission control [3]–[4] to optimize application performance.

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