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SECURE AND ENERGY EFFICIENT ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORK

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ABSTRACT

The exponentially demand of Quality of Service (QoS) communication has made wireless communication as an inevitable technologies. Amongst major at hand technologies, Wireless Sensor Network (WSN) has been found a potential solution to meet major real-world requirements, including monitoring and control, surveillance, healthcare, traffic surveillance and defence systems. Facilitating QoS demands, energy-efficiency and secure communication has always been an open research area for academia-industries. The lack of security not only forces network to undergo compromised situation but also makes it energy exhaustive. On the other hand, providing delay resilient, energy-efficient, higher throughout and secure communication makes WSN robust and efficient. Recently, the use of cryptographic techniques has played vital role towards energy efficient and secure communication. However, enabling robust solution with optimal security techniques in conjunction with improved routing model is an open research area. With this motivation, in this thesis some of the techniques and routing approaches for energy efficient and secure communication for WSN. This study revealed that the use of a time and computation efficient system in conjunction with enhanced routing protocol can ensure secure and energy-efficient communication over WSNs.

Index Terms — Wireless Sensor Network, energy-efficient, Quality of Service.

1. INTRODUCTION

The development of wireless sensor networks (WSNs) is basically toward the miniaturization and ubiquity of computing devices. Sensor networks are composed of thousands of resource constrained sensor nodes and also some resourced base stations are there. All nodes in a network communicate with each other via wireless communication. Moreover, the energy required to convey a message is about twice as great as the energy needed to obtain the same message. The route of each message destination of the base station is actually decisive in terms network lifetime: e.g., using short routes to the base station that contains nodes with depleted batteries may yield decreased network lifetime. On the other hand, using a long route self-possessed of many sensor nodes can expressively increase the network delay.

Wireless communication endowed with numerous advantages over traditional wired network and enables to develop small, low-cost, low power and multi-functional sensing devices. These small sensing devices have the capabilities of sensing, computation, self organizing and communication known as sensors. Sensor is a tiny device used to sense the ambient condition of its surroundings, gather data, and process it to draw some meaningful information which can be used to recognize the phenomena around its environment. These sensors can be grouped together using mesh networking protocols to form a network communicating wirelessly using radio frequency channel. The collection of these homogenous or heterogeneous sensor nodes called wireless sensor network (WSN) [1]. The Energy efficiency is a critical issue in limiting the deploy ability of ad-hoc networks because the energy consumed is an important Quality of service measure for the ad hoc networks. With the tight energy constraints in the ad hoc networks, the energy consumed for data transmission, routes establishment and maintenance should be kept as low as possible. There has been significant effort required to increase the life time of networking and for proposing an energy efficient algorithm. “A better routing algorithm not only increases the lifetime of networks but also speeds up between-node data delivery and accounts for the energy of nodes. The life time of networks, we want to propose a In order to reduce the number of packets that can flood broadcasts in ad hoc networks and to increase novel cluster-based routing mechanism that solves the aforementioned power-balance problems. The main idea here is to use a clustering technique that reduces the number of packets flooding a broadcast.

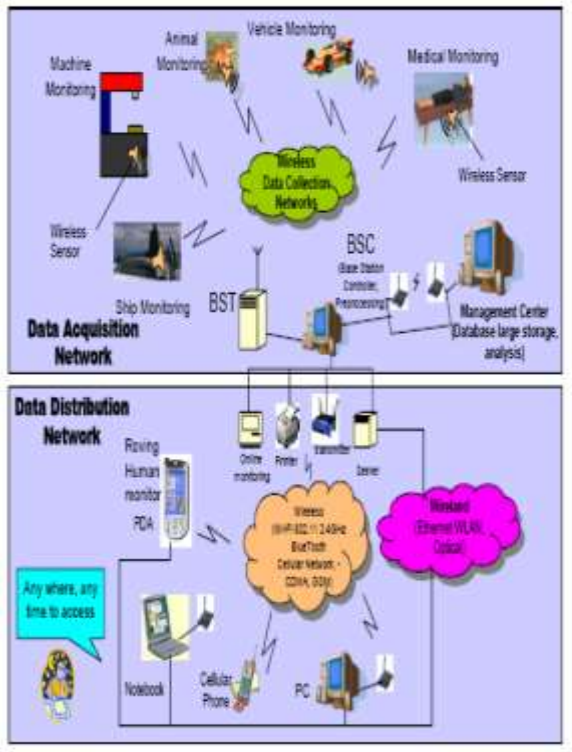

Figure: 1.Wireless sensor networks

To summarize, the challenges we face in designing sensor network systems and applications include:-

1. **Limited hardware**: Each node has limited processing, storage, and communication capabilities, and limited energy supply and bandwidth.
2. **Limited support for networking**: The network is peer-to-peer, with a mesh topology, self-motivated, mobile and untrustworthy connectivity. There are no universal routing protocols or essential registry services.
3. **Limited support for software development**: The tasks are typically real-time and massively distributed, involve dynamic collaboration among nodes, and must handle multiple competing events. Global properties can be specified only via local instructions. Because of the coupling between applications and system layers, the software architecture must be code signed with the information processing architecture The energy efficiency of cooperative communication has recently been investigated in [2] and [3]. The authors of [2] investigated the energy issues in a clustered sensor network, where sensors collaborate on signal transmission and/or reception in a deterministic way. It is shown that, if the long haul transmission distance (between clusters) is large enough cooperative communications can dramatically reduce the total energy consumption still when all the association overhead is considered. Based on [2], the authors in [3] combine the cooperative communication scheme with a cross-layer design framework for multi-hop clustered sensor networks. The system is optimized to improve the overall energy efficiency and to reduce the network delay.

Cooperative communication for clustered sensor networks has also been investigated in [4]. In [5], the authors analyze distributed space-time block coding (STBC)-based cooperative communication for multitier clustered wireless sensor networks. On the basis of their analysis on the SER and throughput performance, the authors show that cooperative communication is more energy well-organized than direct communication. However, the number of cooperative nodes in each cluster is fixed, and the inherent circuit energy consumption of wireless transceivers is ignored, which has recently been reported to be important for low-power wireless sensor networks. In this paper we uses group communication and election algorithm to make the network energy efficient and form secure network for data transmission.

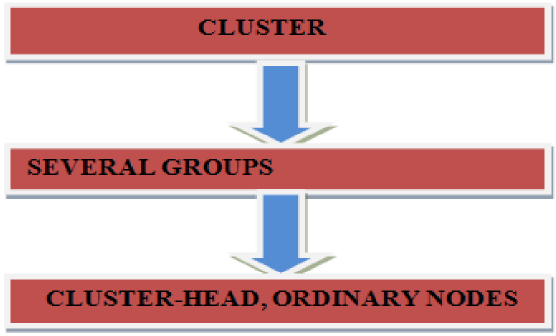

Figure 2: A Group Communication Based System

APPLICATION OF WIRELESS SENSOR NETWORK

Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions that include the following [7]

- temperature
- humidity
- vehicular movement
- lightning condition
- pressure
- soil makeup
- noise levels
- the presence or absence of certain kinds of objects
- mechanical stress levels on attached objects, and
- the current characteristics such as speed, direction and size of an object

Sensor nodes can be used for continuous sensing, event detection, event ID, location sensing, and local control of actuators. The concept of micro-sensing and wireless connection of these nodes promises many new application areas. We categorize the applications into military, environment, health, home and other commercial areas. It is possible to expand this classification with more categories such as space exploration, chemical processing and disaster relief.

2. PROPOSED METHODOLOGY

Group Communication

The energy efficiency of cooperative communication has recently been investigated in and The authors of investigated the energy issues in a clustered sensor network, where sensors collaborate on signal transmission and/or reception in a deterministic way. It is shown that, if the long haul transmission distance (between clusters) is large enough, cooperative communications can dramatically reduce the total energy consumption still when all the association overhead is considered. Based on the authors in combine the cooperative communication scheme with a cross-layer design framework for multi-hop clustered sensor networks. The system is optimized to improve the overall energy efficiency and to reduce the network delay.

Cooperative communication for clustered sensor networks has also been investigated in In the authors analyse distributed space-time block coding (STBC)-based cooperative communication for multitier clustered wireless sensor networks. Based on their analysis on the SER and throughput performance demonstration that cooperative communication is greatly more energy proficient than direct communication. Conversely, the number of cooperative nodes in each cluster is fixed, and the inherent circuit energy consumption of wireless transceivers is ignored, which has recently been reported to be important for low-power wireless sensor networks. In this paper we uses group communication and election algorithm to make the network energy efficient and form secure network for data transmission.

Algorithm

An Election algorithm is a particular principle algorithm, which is run for selecting the coordinator procedure among N number of procedures. These coordinator or leader process plays a significant role in the distributed system to sustain the consistency through synchronization. For example, in a system of client server mutual exclusion algorithm is preserved by the server process Ps, which is chosen from among the processes Pi where i=1, 2... N that is the group of processes which would use the crucial region. Election Algorithm is essential in these circumstances to prefer the server process among the existing process. Eventually all the processes must agree upon the leader process. If the coordinator process fails due to diverse reasons then instantly the election should happen to choose a new leader process to take up the job of the failed leader. Whichever process can instigate the election algorithm whenever it encounters that the failure of leader process. There can be situations that all N processes could call N synchronized elections. In anytime, process Pi is one amongst the following two states, when the election happens: Participant refers to the process is directly or indirectly involved in election algorithm, no participant refers to the process in not engaged with the election algorithm currently. The goal of Election Algorithm is to choose and declare one and only process as the leader even if all processes participate in the election and at the end of the election, every process should agree upon the new leader process without any mystification. With no loss of simplification, the elected process should be the process with the largest process identifier. This may be any number demonstrating the order /birth/ priority/ energy of the process. All the process has a changeable called LEAD, which contains the process id of the current leader. When the process participates in the election, it sets this lead to NULL. Any Election Algorithm should assure the following two belongings.

Safety: Any process P, has LEAD = NULL if it is participating in the election, or its LEAD =P, where P is the highest PID and it is alive at present.

Likeness: All the processes should agree on the chosen leader P after the election. That is, LEAD = PID Pi where i=1, 2... N.

3. RESULT

We have discussed an improved algorithm in previous section and it is compared with previous algorithm. The implementation of an algorithm is done in well known network simulator NS-2.34. The simulation environment is setup to simulate the algorithm in which we take an area of 900x900 to transmit the packet CBR/TCP protocol AODV is used and the node consist the energy 0.45 joule for the simulation time 400s. In this work, mainly focuses for providing better security by consuming less energy. The comparison of above is done using different parameter such packet delivery ratio, throughput, routing load, delay etc.

Packet delivery ratio

Packet delivery ratio is defined as the ratio of data packets received by the destinations to those produced by the sources. Mathematically, it can be defined as:

$PDR= S1 \div S2$

End to end delay:

The average time taken to transmit a data packet to reach the destination. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue. This metric is calculated by deducting time at which first packet was transmitted by source from time at which first data packet arrived to destination.

Mathematically, it can be defined as:

Avg. EED=S/N

Total Packet Dropped: When no route is found for the destination, the node drops the packets queued to the destination.

Total Replies Sent From Destination: Once a destination node receives a route request, it sends a route reply to the source of the source of the request. This statistic represents the whole number of route reply packets sent from all nodes in the network if they are destination by everynode in the network.

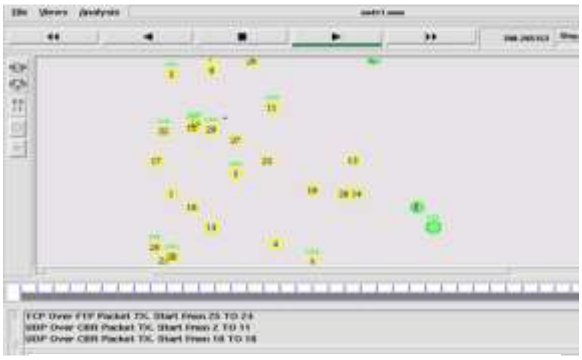

Figure 3: A Snapshot of scenario setup for energy efficient routing

In general, packet delivery ratio decreases as the number of load and network size were increased. The proposed algorithm is compared with the existing method in which our method provides larger no of the packet delivery ratio as varying simulation time Vs Packet delivery ratio.

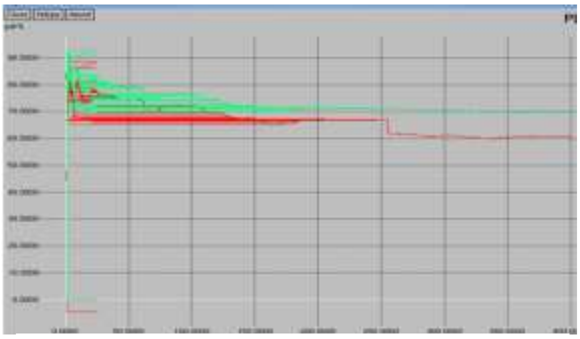

Figure 4: Comparison of simulation time Vs PDR% with existing and proposed methodology

The undesirable increase in End-to-End delay could be observed in compared when the network size increases. In our work, the end to end delay is calculated increase in network size with respect to simulation time. The simulation result of proposed work decreases the delay comparing with the existing methodology.

Network size Vs Simulation time

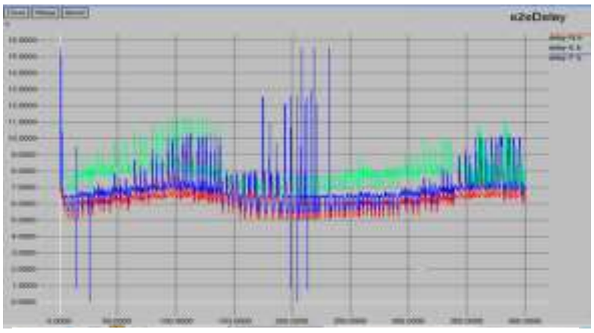

Figure 5: Comparison of simulation time Vs network size with existing and proposed methodology

4. CONCLUSION

The basic requirement for the wireless communication, secure and energy efficient network is the primary requirement which can be influence by different malicious node while the sensor node has limited energy constraints to transmit the packets. In this paper we proposed group communication method using election/bully algorithm to lessen the consumption ratio of nodes energy. The comparison of proposed algorithm is done with the existing methodology among different measuring parameter such as packet delivery ratio, throughput, end-to-end delay; routing load and the packet information of each node.After simulating an algorithm, the simulation result proves that method is more dexterous than the existing method. But, it has some limitation as we increase the load packet dropping also increases and hence, in future work designs such algorithm which can greatly reduce the packet drop.

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