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CLUSTER BASED ENERGY EFFICIENT ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS

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Abstract- Energy conservation and load balancing of the sensor nodes are the important issues considered in the design of Wireless Sensor Network WSN). By using clustering approach, the energy consumption of nodes in the network can be decreased thereby increasing its lifetime. In various multi-hop cluster-based routing protocols, nodes nearer to the Base Station (BS) exhaust their energy quickly than other nodes as data from the entire network is forwarded to BS through them. Due to this, nearby nodes die sooner and network get partitioned. This is known as hot spot problem. In this work I implement Fermat point based Secure Data Aggregation Protocol (SDAP) which eliminates the redundant data transmission over the network, thereby increasing the energy efficiency of the network and we can avoid the hotspot problem.

Keywords- additive white Gaussian noise, Low Energy Adaptive Clustering Hierarchy, Network simulator, Secure Data Aggregation Protocol, Wireless Sensor Network

I. INTRODUCTION

1. WIRELESS SENSOR NETWORKS

Energy-Harvesting systems, which collect energy from environmental energy sources such as solar, radio frequency, or temperature gradients, etc., have recently arisen as a viable alternative for communication devices that require a sustainable energy supply system to replace a fixed power supply or rechargeable batteries. Most of the research work on energy-harvesting wireless networks has been based on the simple point-to-point model, where an energy-harvesting source node transmits data to a destination node. Since the arrival of harvested energy at the transmitter's battery is arbitrary, energy consumption must be carefully optimized based on the current battery state and data buffer so as to improve performance. The capacity of additive white Gaussian noise (AWGN) channels for energy-harvesting point-to-point communication has already been the subject of research from the information-theoretic perspective. To maximize throughput and minimize transmission delay on fading channels, transmission policies for energy-harvesting transmitters were developed considering the causal or non-causal information concerning channel state and energy arrival. Moreover, an adaptive policy that changes the transmission rate based on randomly arriving data traffic in Energy-harvesting communication was studied.

Advancements in technologies from different research areas that have contributed to the research and development of sensor networks are sensing, communication, and computing. Similar to the development of many other technologies, research and development in sensor networks was initially driven by the requirement for defense applications. For example, the Sound Surveillance System (SOSUS) was deployed at strategic locations on the ocean bottom to detect and track quiet submarines during the Cold War. Modern research on sensor networks began in the late 70's with the Distributed Sensor Networks (DSN) program at the Defense Advanced Research Projects Agency (DARPA) with the identification of various technological components for DSN in Distributed Sensor Nets workshop in 1978.It is the recent technological advances in the field of micro-electro-mechanical systems (MEMS) that have made the development of tiny, low cost, low powered and multifunctional sensor nodes technically and economically feasible. These nodes are usually equipped with a sensing unit, a processing unit, and an RF communication unit, and are operated by lightweight batteries. Although the capability of individual sensor nodes is limited, a sensor network is usually able to perform bigger tasks through the collaborative effort of a large number of nodes (hundreds or even thousands) that are densely deployed within the sensing field.

II. BACKGROUND

Recently wireless sensor networks (WSN) have gained great popularity, mainly because they provide a low cost alternative to solving a great variety of real world problems. Their low cost Enabled the deployment of large amounts of sensor nodes (in the order of thousands, and in the future perhaps millions), which most of the time operate under harsh environments. WSN present extreme resource limitations, mainly in available memory space and energy source. Both limitations represent great obstacles for the integration of traditional security techniques. The highly unreliable communication channels that are used in WSN and the fact that they operate unattended make the integration of security techniques even harder. Wireless sensor networks today offer the processing capabilities of computers of a few decades ago and the industry's trend is to reduce the cost of wireless sensing nodes while maintaining the same processing power. Based on this idea, many researchers have started to face the challenge of maximizing processing capabilities and reducing energy consumption while protecting sensor networks from possible attacks.

III. LITERATURE SURVEY

Heinzelman et al. [7] introduced LEACH (Low Energy Adaptive Clustering Hierarchy) which is the first protocol based on clustering approach. This protocol suffers from uneven number of CHs in subsequent rounds which produce complexity. Heinzelman et al. [8] proposed LEACH-C. It has fixed number of CHs in each round. It is BS controlled protocol, which reduces the overhead of CH selection from the nodes. Authors in [9] described LEACH-F in which clusters are formed only once at the beginning of the setup phase for the entire lifetime of the network. This protocol doesn't allow new sensor nodes to be added to the network and uses single hop communication to the BS. Biradar et al. [10] have proposed multi-hop LEACH. In this protocol, an optimum multi-hop tree is created between all CHs keeping BS as root node and communication takes place through this path. This increases network lifetime. Qiang et al. [11] have proposed MS-LEACH which uses single-hop as well as multi-hop transmission for intra cluster conul1unication depending on the size of the cluster. Farooq et al. [12] have proposed MRLEACH in which BS divides network into layers based on the hop distance of the CHs. Each lower layer CH sends data to the nearest upper layer CH for communicating to the BS.Ashlyn et al. [13] have proposed EEM-LEACH. In this protocol, nodes near to the BS communicate directly with the BS as they don't belong to any cluster. This protocol is designed on the basis of minimum communication cost. All the protocols mentioned in [10],[11],[12],[13] increases the lifetime of the network in comparison to single-hop transmission based protocols but suffers from hot spot problem. Due to large traffic load near the BS, nodes nearer to the BS exhaust their energy rapidly in comparison to other far away nodes. Multi-hop route formation among nodes is an overhead in multi-hop routing protocols which decreases lifetime and increases complexity of the network. Liu et al [14] proposed a grid based algorithm LPGCRA (Low Power Grid Based Cluster Routing Algorithm). It addresses the hot spot problem but it has its own drawbacks. All nodes within the cluster consume more energy if CH is far away from its member nodes and CHs transmit aggregated data directly to the BS. Amrutha et al. [15] have proposed another grid based protocol GBR (Grid Based Routing). In this protocol, node nearest to the BS in a grid is selected as CH. So, member nodes consume their energy more quickly. Sugihra et al. [16] have proposed a data mule based protocol to increase the network lifetime. It is an alternate to multi-hop data forwarding. In this protocol, data mule (a mobile device) collects data from the nodes by physically visiting them. Hence, it decreases the energy consumption by the nodes and increases network lifetime. But time latency is a major issue in this protocol.

IV. SYSTEM STUDY

1. EXISTING SYSTEM

Energy conservation and load balancing of the sensor nodes are the important issues considered in the design of Wireless Sensor Network (WSN). By using clustering approach, the energy consumption of nodes in the network can be decreased thereby increasing its lifetime. In various multi-hop cluster-based routing protocols, nodes nearer to the Base Station (BS) exhaust their energy quickly than other nodes as data from the entire network is forwarded to BS through them. Due to this, nearby nodes die sooner and network get partitioned. This is known as hot spot problem. This paper proposes an energy efficient uneven grid clustering based routing (EEUGCR) protocol for larger network area. The proposed protocol is based on the centralized approach which uses fixed clustering. In this protocol, the BS divides the whole network into fixed rectangular shaped clusters of unequal size. The size of the cluster is dependent on its distance from the BS. To overcome from more energy loss at the clusters nearer to the BS due to more data handling, proposed protocol introduces unequal size grid clustering approach. It also ensures that the transmission distance for any communication in the network is less than the threshold distance of the energy consumption model. It also increases load balancing in terms of energy consumption and data traffic. It can provide better solution to hot spot problem and hence can improve network lifetime with respect to other existing routing protocols.

2. PROBLEM DEFINITION

Especially from an industry perspective, the major barrier to the wide adoption of wireless sensor networks technology are the lack of easiness in WSN programming, the lack of installation ease, and the big concern about the reliability, interference, and the robustness to the dynamicity of the environment and also the battery lifetime.

For this, data aggregation is also to be embedded in the protocol on which security is to be applied. This will serve both the purposes i.e. to minimize energy consumption and to secure the transmission.

3. PROPOSED SYSTEM

Sensor networks are increasingly deployed for applications such as wildlife habitat monitoring, forest fire prevention, and military surveillance. In these applications, the data collected by the sensor nodes from their physical environment need to be assembled at a host computer or data sink for further analysis. Typically, an aggregate (or summarized) value is computed at the data sink by applying the corresponding aggregate function e.g., MAX, COUNT, AVERAGE or MEDIAN to the collected data. A primary goal in the design of wireless sensor networks is to extend the network lifetime and to build the energy efficient network. In this work we implement Fermat point based Secure Data Aggregation Protocol (SDAP) which eliminates the redundant data transmission over the network, thereby increasing the energy efficiency of the network.

A. PROPOSED SDAP IN WSN

Data aggregation is being used to minimize the energy consumption in transmitting data multiple times. Fermat point is the median of polygon having shortest distance from all the vertices of polygon (JyotiKaurav 2013). So, obviously if the data is being travelled from the Fermat point, it will cover the shortest distance. Fermat point is an imaginary point and data cannot be transmitted to it so the Fermat node i.e. the node nearest to the Fermat point is obtained and then the data is send to the Fermat node and aggregation takes place.

Figure 1show the number of transmissions with Fermat point based Secure Data Aggregation Protocol (SDAP). By using the Fermat point concept for data aggregation so the number of transmissions are almost reduces by half. The ratio by which the number of transmissions are reduces depends upon for how many sources the node acts as the Fermat node.

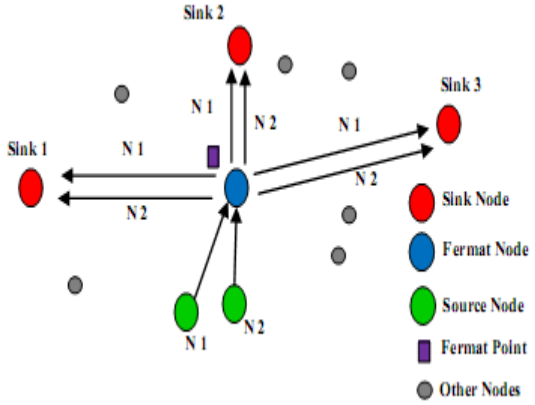

Fig 1. Data Transmission with Fermat Point based SDAP

B. DATA AGGREGATION ALGORITHM

1. Source Node-> Plaint Text to Fermat Node
2. Fermat Node->Data Aggregation and Encryption on Aggregated data
3. Sink node-> Decrypt
4. Keep a check when data reaches NF_ID; wait for 1 second before transmitting it to sinks.
If Within that time other data reaches from nodes for which it is also acting as NF_ID then Aggregate, Encrypt and transmit Else Encrypt and transmit
5. Exit

V. SIMULATION RESULTS

A. THE NETWORK SIMULATOR

Network Simulator (NS2) is a discrete event driven simulator developed at UC Berkeley. It is part of the VINT project. The goal of NS2 is to support networking research and education. It is suitable for designing new protocols, comparing different protocols and traffic evaluations. NS2 is developed as a collaborative environment. It is distributed freely and open source. A large amount of institutes and people in development and research use, maintain and develop NS2. This increases the confidence in it. Versions are available for FreeBSD, Linux, Solaris, Windows and Mac OS X. Network simulator (NS) is an object–oriented, discrete event simulator for networking research. NS provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. The simulator is a result of an ongoing effort of research and developed. Even though there is a considerable confidence in NS, it is not a polished product yet and bugs are being discovered and corrected continuously. NS is written in C++, with an OTcl1 interpreter as a command and configuration interface. The C++ part, which is fast to run but slower to change, is used for detailed protocol implementation.

The OTcl part, on the other hand, which runs much slower but can be changed very fast quickly, is used for simulation configuration. One of the advantages of this split-language program approach is that it allows for fast generation of large scenarios. To simply use the simulator, it is sufficient to know OTcl. On the other hand, one disadvantage is that modifying and extending the simulator requires programming and debugging in both languages.

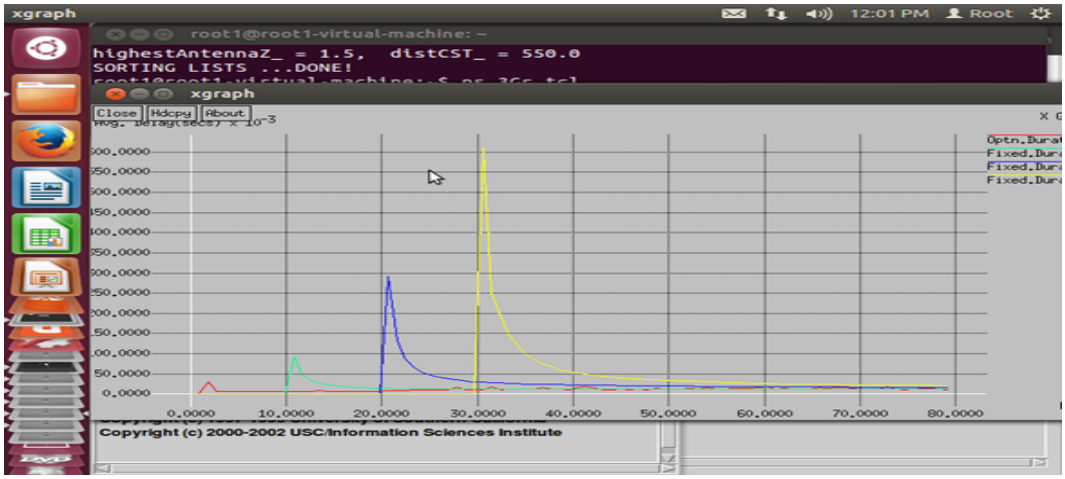

Fig2. Energy with sensor networks

B. SDAP ON ENERGY CONSUMPTION IN WSN

The energy consumption of sensor node is decreased by using SDAP.

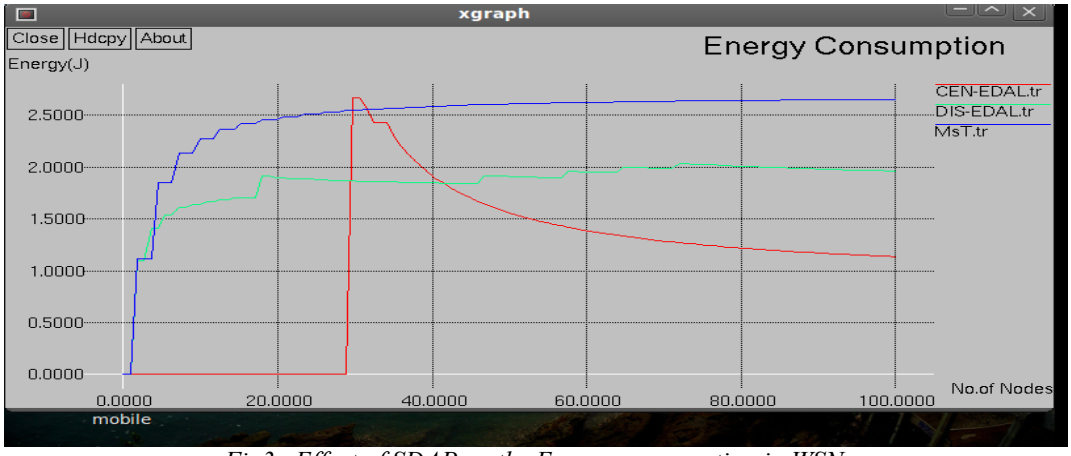

Fig3. Effect of SDAP on the Energy consumption in WSN

The above graph result shows that the Fermat Point based Secure Data Aggregation Protocol (SDAP) in heterogeneous network is more energy efficient than the homogeneous network.

C. DATA TRANSMISSION USING SDAP

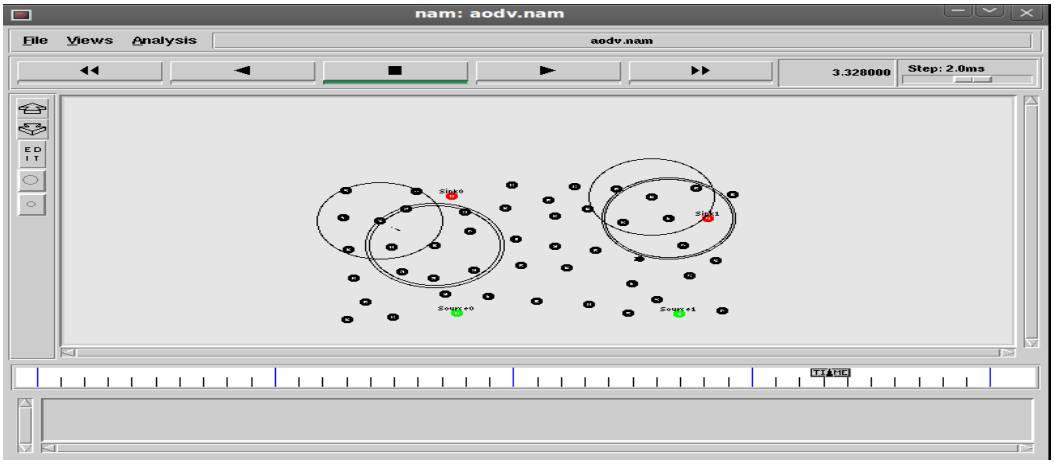

Fig 4.data transmission using SDAP

The simulation result shows the data transmission among the sensor nodes by using Fermat point based Secure Data Aggregation Protocol (SDAP).The proposed model eliminates the redundant packets at the Fermat node and helps in reducing the energy consumption of a sensor node and prolong the lifetime of a Wireless Sensor Networks.

VI. CONCLUSION

The simulation had been conducted for the network of fifty `nodes. The simulation result shows that how the Fermat Point based SDAP in heterogeneous network can help in minimizing the total energy consumption and maximizing the lifetime improving the energy efficiency of a WSN by reducing the number of packets needed, and enabling a high increase in energy efficiency.

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