

## International Journal of Computer Science and Mobile Computing



A Monthly Journal of Computer Science and Information Technology

ISSN 2320-088X

*IJCSMC, Vol. 3, Issue. 3, March 2014, pg.908 – 914*

### **RESEARCH ARTICLE**

# Energy Saving in Wireless Sensor Network using Attribute Based Dynamic Routing

G.Subha<sup>1</sup>, M.Nava Bharathy<sup>2</sup>

<sup>1</sup>Department of Embedded System Technologies, Anna University, India

<sup>2</sup>Department of Computer Science and Engineering, Anna University, India

<sup>1</sup>[subhacateshri@gmail.com](mailto:subhacateshri@gmail.com)

---

*Abstract-- In wireless sensor networks the sensor nodes are deployed in various environments for monitoring temperature, pressure and some other purposes. These sensor nodes have limited energy and cannot be reenergized easily. So to utilize the energy efficiently, this project proposes an attribute based energy saving mechanism. Here the information sensed by the sensors are aggregated based on packet attribute which is inspired by the concept of pheromone in ant colony optimization. The data sensed by the sensors are sent to sink by various path based on potential based dynamic routing protocol. Thus it reduces the redundant information produced by the adjacent sensors and also provides the information with accuracy. If the sensor nodes are compromised or the information is modified by an adversary then it will be critical for the user to use that information. So the data must be encrypted and then send to the base station.*

*Keywords-- Attribute, encryption, Potential field, dynamic routing, aggregation*

---

## I. INTRODUCTION

A wireless sensor network is a collection of large number of nodes. These nodes sense the physical quantities such as temperature, pressure and humidity into electrical quantity. The electrical signal which is an analog signal is then converted into digital signal by an Analog to Digital converter circuit. The digital signal is then processed and sent to Receiver. The Receiver side has a Digital to Analog converter which converts the digital signal backs to an Analog signal and then sends to base station. The sensor nodes are very small electronic devices produce a measurable response with respect to change in environmental conditions. The energy for these sensor nodes are supplied by the limited power source of less than 0.5-2 ampere per hour and 1.2-3.7 volts.

In order to reduce the more number of transmissions the packets with the same attribute are grouped together. Sensor nodes are used in various applications such as military, habitat, health, home monitoring and other commercial applications. In order to improve the efficiency of wireless sensor networks the issues to be considered are fault tolerance, scalability, production cost etc. In fault tolerance, if any sensor node fails then it won't affect the performance of overall Network. The scalability specifies the number of nodes used from hundreds to thousands or

millions depends on the application. The production cost includes the total cost involved in creating the whole sensor Network. The data fusion is a technique to aggregate the data from multiple sources. This technique is used in single application wireless sensor networks where the sensor nodes measure the data from homogeneous sensors. The proposed mechanism uses attribute based data aggregation to group the data available from heterogeneous sensors. The mechanisms used for data aggregation are sum, average, maximum, minimum, median and mode. The wireless sensor network consists of thousands of nodes. The data sensed by the adjacent sensor nodes are mostly correlated both in temporal and spatial. So if these sensed packets are sent directly to sink, it increases the WSN traffic with packet redundancy and leads to wastage of energy. So the packets are aggregated at some intermediate nodes and then sent to sink. It decreases the redundancy and Network traffic.

Based on the aggregation the Network can be classified as hierarchical and flat Network. In flat network all the sensor nodes are assumed to be the equal energy nodes. Thus sink floods the query to all nodes in sensor networks. The nodes which have the matching content with that of query send the response back to sink. Here the energy is very much wasted. Examples of this type of Networks are Spin, Directed Diffusion, Roumar Routing, Gradient Based Routing, CADR, ACQUIRE and Energy Aware Routing. In hierarchical network the data aggregation is done at some intermediate cluster heads and then the data is transmitted to sink. Thus it reduces network traffic and wastage of energy compared with that of flat network. The Hierarchical Network is further classified into static and dynamic. The examples of hierarchical Networks are LEACH, PEGASIS, TEEN, APTEEN and Energy Aware Routing for Cluster Based Sensor Network.

## II. RELATED WORK AND MOTIVATION

### A. Related Work

The data fusion technique is used in existing system to perform aggregation operations such as average, sum, minimum, maximum etc in homogeneous environment whereas to aggregate data in heterogeneous environment attribute based aggregation is proposed. Hue *et al.* [5] proposed an optimized scheduling mechanism. This mechanism is based on centralized feedback timing control in which the base station calculates the maximum time interval between successive aggregations. Fan *et al.* [4] proposed a scheme in which waiting time for each aggregation is random. Younis *et al.* [3] proposed LEACH (Low Energy Adaptive Clustering Hierarchy) Algorithm for data aggregation. This method is suitable for controlling the network based on current network status and energy level. The randomly selected cluster head aggregates the data that arrives from multiple sensor nodes. It uses Time division/Code division multiple access to reduce inter/intra collisions.

Heinzelman *et al.* [1] proposed HEED (Hybrid Energy Efficient Distributed Protocol). Here it uses residual energy as a primary parameter and other factors such as node degree and distant to neighbors are considered as a secondary parameters. Lindsey *et al.* [2] proposed chain based data aggregation scheme known as PEGASIS (Power Efficient Gathering in Sensor Information Systems). Here the node which is far away from sink initiates the chain using greedy algorithm. The nodes which have shorter distance from the sink find its neighbor and send the aggregated result. This is continued until the data reaches the sink or base station. Park *et al.* [8] proposed a hybrid routing protocol which combines both the concept of clustering and shortest path tree. Here the clustering head performs aggregation and then the shortest path is found out to reach the sink.

### B. Motivation

The proposed scheme of our attribute based data aggregation using potential based dynamic routing scheme is inspired by the concept of potential in physics and pheromone in Ant Colony Optimization algorithm. The potential is the amount of energy needed to transmit a packet from one node to another. Theraulaz *et al.* [6] proposed the concept of Ant Colony Optimization algorithm which inspired to design proposed dynamic routing ADA scheme. Caro *et al.* [9] proposed the dynamic routing protocol for wired and wireless network. In Ant Colony Optimization Algorithm, ants wander here and there for searching food. After finding a food, it returns to its colony and it deposits pheromone in the travelled path. Each pheromone have different odor. The other ant which belongs to the same group comes along the path is attracted by the deposited pheromone and uses that path thereafter. The deposited pheromone is evaporated after some time. This evaporation is also useful for finding the optimal shortest

path. Since if the deposited pheromone is not evaporated then the entire ant will use the same path without considering whether the path is longer or shorter, optimal or not.

In our proposed scheme, the packets are considered as ants and packet attribute is related to pheromone. The packet attribute is left on nodes when packets of heterogeneous environment are passed through the node. The attribute is different for each application. Here the odor is more if more number of packets with same attribute passed through that path. To update the routing table efficiently it inject extra packets into networks like forward ants and backward ants in ant colony and also distribute the status information such as neighbor node, node density into network routing table. Here one potential field is based on network topology to ensure the entire packet to reach the sink. The other potential field is based on pheromone to attract the packets with same attribute. Combining these fields a virtual hybrid potential field is developed to support our dynamic routing ADA scheme. The packet driven timing algorithm and potential based dynamic routing is used converge the packets both in temporal and spatial. It simplifies the packet meet at each other at some node for data aggregation.

### III. METHODS FOR CONSTRUCTING ADA AND PBDR

#### A. Attribute Based Data Aggregation

The ADA scheme design considers the depth, neighbor and attribute. The depth specifies the number of hops from sensor node to base station. The neighbor field specifies the immediate neighbor node from each node. The attribute field is different for each application. The identifiers are provided for specifying the different attribute to measure the various types of signals.

#### B. Potential Based Dynamic Routing

In potential field model, the potential is like a bowl located at bottom and the water is flow down to bowl. Similarly the packet reaches sink located at some distance. Attribute potential field is created to collect packets with same attribute together. The potential difference acting on two neighbor node is calculated by

$$F_{u \rightarrow v} = V(u) - V(v) \quad (1)$$

Depth potential field is calculated by

$$F_{u \rightarrow v}^d = D(u) - D(v) \quad (2)$$

It is used to ensure the entire packet to reach the sink correctly. Pheromone potential field is calculated by

$$F_{u \rightarrow v}^p(\delta) = V_p(u, \delta) - V_p(v, \delta) \quad (3)$$

The pheromone potential field is used to group the packets with same attribute together.

The hybrid potential field is calculated by

$$F_{u \rightarrow v}^h(\delta) = (1 - \alpha)F_{u \rightarrow v}^d + \alpha F_{u \rightarrow v}^p(\delta) \quad (4)$$

The hybrid potential field is used to group the packets more spatially and temporally. The data generated by two different applications in a heterogeneous environment cannot be aggregated together.

#### C. Adaptive Packet driven timing Algorithm

The packets which are travelling through the same path have to meet at each other for aggregation in a particular time based on the number of hops from source node to sink. The relationship between delay and hop is used to calculate the waiting time. It is denoted by  $W_i$ .

$$W_i = (T - shd \times h_i) \quad (5)$$

h represents hop count and shd represents delay. After waiting for this particular waiting time the nodes aggregate the packets and send the aggregated data to sink.

The neighbor nodes have same or large depth is not selected as the next hop by PBDR. This can be selected by

$$\alpha < \frac{S(1-p)}{1+S(1-p)} \quad (6)$$

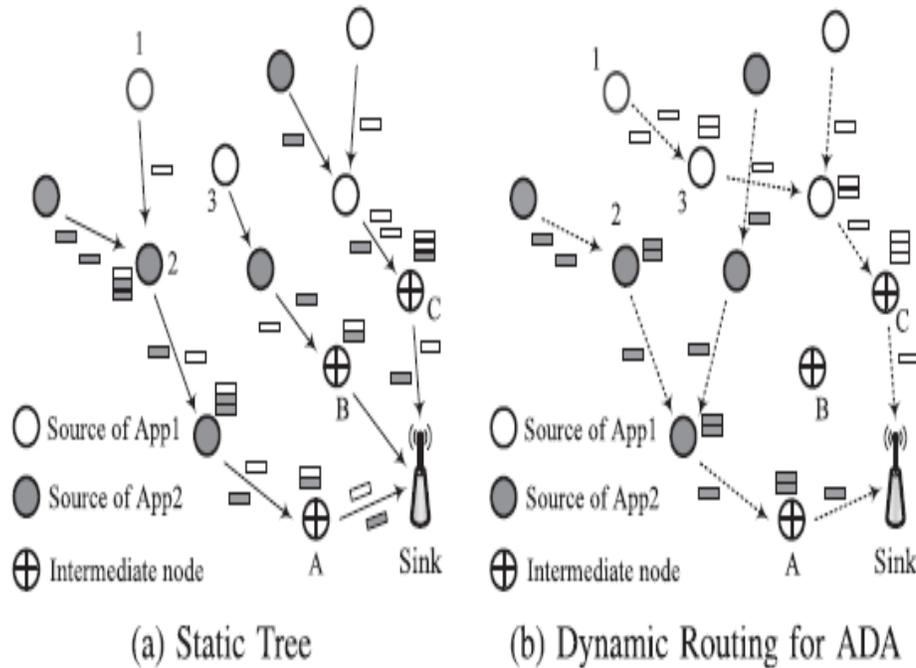
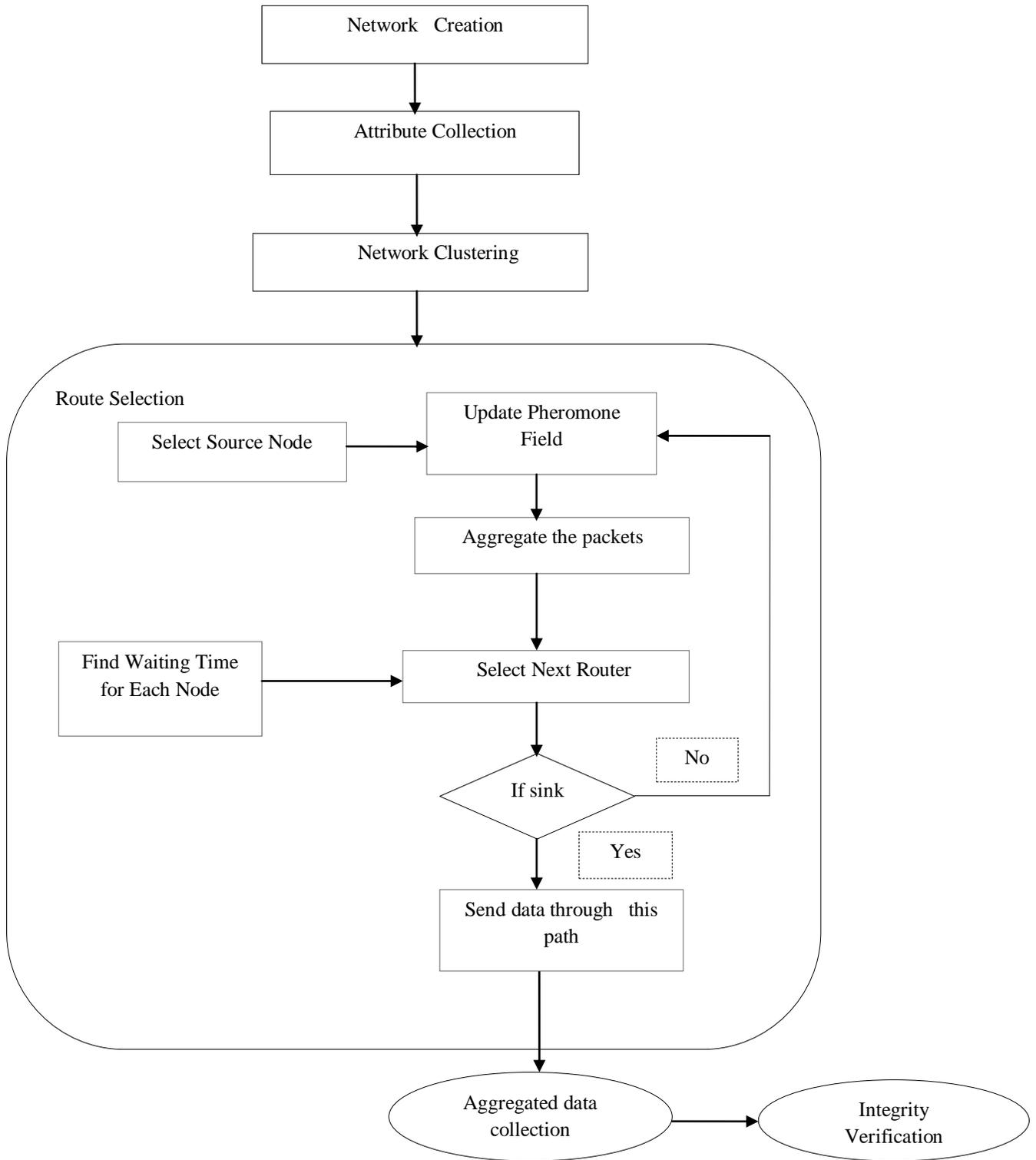


Fig 1 Static and Dynamic Routing In ADA Scheme

Consider two applications such as measuring temperature and pressure. If we aggregate these two data then it is meaningless. So our proposed scheme uses attribute based data aggregation. So the temperature and pressure data can be aggregated separately and send to sink. The app1 measure temperature and app2 measure pressure. The intermediate node is the cluster head which performs data aggregation. In fig (a) the network is predetermined. So it groups the packet via the same static path. But in fig (b) the dynamic route is updated based on current network status. So it reaches the sink quickly and also supply the data with more informative and accuracy.

D. Flow Diagram:



#### *E. Stages Involved In Designing The Project*

- 1) *Network Creation*: Here the sensor nodes are established based on several topologies or in an ad hoc manner. The sensor nodes are located within 10 feet and the node density may be  $20 \text{ nodes}/\text{m}^3$ .
- 2) *Attribute Collection*: Different types of attributes such as temperature, pressure or traffic used to monitor heterogeneous environment is collected and the natural numbers are used as an identifier for specifying the type of an attribute.
- 3) *Network Clustering*: The sensor nodes are clustered based on the application of the sensors. For example, nodes measuring temperature quantity is clustered.
- 4) *Routing Selection*: The route is selected dynamically based on the concept of ant colony optimization algorithm.
- 5) *Update Pheromone*: The packet attribute which is considered as a pheromone in ant colony is updated to perform dynamic routing.
- 6) *Find Waiting Time*: The nodes need to wait some time before transmitting the packets. It is calculated based on the concept of adaptive packet driven timing algorithm.
- 7) *Aggregation*: The cluster head aggregates the data, encrypt it and then send to sink.
- 8) *Integrity Verification*: The Sink decrypts the data with the corresponding key and then check for Integrity.

#### *F. Performance Considerations*

- 1) *Transmission rate*: It is the ratio of total number of transmission occurs at the network to the total number of packets reaches the sink successfully.
- 2) *Aggregation count*: If more packets reaches the sink, then aggregation count is small otherwise the aggregation count is large.
- 3) *Network Life time*: It is the number of aggregation rounds completed when some of its sensors lose its energy completely.

### **IV. SECURITY IN WSN**

The main challenge in wireless sensor network is to maintain confidentiality and integrity of data since the adversary may drop or modify the packets, compromise the secrets or injecting unwanted data to packets. So the security is provided based on two schemes such as Link to Link Encryption and End to End Encryption.

In Link to Link Encryption, each link is equipped with an encryption device. So all the traffic over the link is secure. But here the packet is decrypted at each node to read the packet header to forward the packet. In End to End Encryption scheme, the encryption process is carried at both end of the device. The source encrypts the data and then the packet is transmitted to sink without any alteration. Here the packet is not encrypted so it not necessary to decrypt the packet at each node. By using this any one of the encryption mechanism security is provided.

After the cluster heads aggregate all packets with same attribute it encrypts the packet. After encryption the plaintext is converted into cipher text. The key for encryption is provided by the base station. So each node shares a secret key with the base station. The key may be symmetric or asymmetric. In symmetric key cryptography, it uses a single key. Our proposed scheme uses asymmetric cryptography. Here two keys are involved such as private key and public key. After encrypting the plaintext with the key the hash code is generated. At the Receiver side, the sink decrypts the packet with the corresponding key. Thus the integrity of the message of the message is checked.

### **V. CONCLUSION**

The attribute aware data aggregation scheme is efficient for multi-application environment where the sensor nodes are equipped with various sensors for sensing different environments. Since the energy is limited in wireless sensor networks, the ADA scheme reduces the energy consumption by reducing the number of transmissions. The dynamic routing algorithm which is inspired by the concept of ant colony optimization algorithm is to find out the optimal shortest path from source node to sink to send the aggregated data. The encryption mechanism is used to send the data to sink without any alteration. Thus this project proposes an energy saving and secure sharing in wireless sensor network using attribute based aggregation and encryption.

## REFERENCES

- [1] W.R.Heinselmann, A.Chandrakasan, and H.Balakrishnan,"Application Specific protocol Architecture for Wireless Networks," IEEE Transactions on Wireless Communication, vol.1, no. 4, page.660-670, October 2002
- [2] S.Lindsey, C.Raghavendra, and K.M.Sivalingam,"Data Gathering Algorithms in Sensor Networks Using Energy Metrics," IEEE Transactions on Parallel and Distributed Systems, vol. 13, no. 9, page. 924-935, September 2002.
- [3] O.Younis and S.Fahmy,"HEED: A Hybrid, Energy-Efficient, Distributed Clustering Approach for Ad Hoc Sensor networks," IEEE Transactions on Mobile Computing, vol.3, no.4, page. 336-379, December 2004.
- [4] K.Fan, S. Liu and P.Sinha, "On the Potential of Structure-Free Data Aggregation in Sensor Networks,"Proceedings of IEEE INFOCOM, pp.1-12, April 2006.
- [5] F.Hu, X.Cao, and C.May, "Optimized Scheduling for Data Aggregation in Wireless Sensor Networks," Proc. Int'l Conf. Information Technology: Coding and Computing (ITCC'05), pp.156-168, 2005.
- [6] Theraulz and E.Bonabeau,"A Brief History of Stigmergy,"Artificial Life, vol.5, no 2, page 66-71, 2003
- [7] W.Pu, D.Rui, and I.Akyildiz,"Collaborative Data Compression Using Clustered Source Coding for Wireless Multimedia Sensor Networks,"Proc.IEEE INFOCOM, pp.1-9, 2010
- [8] S.J. Park and R.Sivakumar, "Energy Efficient Correlated Data Aggregation for Wireless Sensor Networks", International Journal on Distributed Sensor Networks, vol.9, no.1, pp.317-365, 1998.
- [9] G.D. Caro and M. Dorigo, "AntNet: Distributed Stigmergetic Control for Communication Networks," J.Artificial Intelligence Research, vol.9, no.1, pp.317-365, 1998
- [10] Q.Fang, F. Zhao, and L. Guibas," Lightweight Sensing and Communication Protocol for Target Enumeration and Aggregation," Proc. Fourth Int'l ACM Symp.Mobile Ad Hoc Networking and Computing, 2003.