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Energy Efficient Data Aggregation using Packet Driven Timing Algorithm in Wireless Sensor Network

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Abstract

Energy in wireless sensor networks (WSNs) are quite limited. Since sensor nodes are usually much dense, data sampled by sensor nodes have much redundancy, data aggregation becomes an effective method to eliminate redundancy, minimize the number of transmission, and then to save energy. Many applications can be deployed in WSNs and various sensors are embedded in nodes, the packets generated by heterogenous sensors or different applications have different attributes. The packets from different applications cannot be aggregated. Otherwise, most data aggregation schemes employ static routing protocols, which cannot dynamically or intentionally forward packets according to network state or packet types. The spatial isolation caused by static routing protocol is un favourable to data aggregation. To make data aggregation more efficient, in this paper, we introduce the concept of packet attribute, and then propose an attribute-aware data aggregation (ADA) scheme consisting of a packet-driven timing algorithm and a special dynamic routing protocol. Inspired by the concept of potential in physics and pheromone in ant colony, a potential-based dynamic routing is elaborated to support an ADA strategy it.
Keywords: Attribute aware data aggregation, Dynamic routing protocol, Packet driven timing control algorithm, wireless sensor network

I. Introduction

Wireless sensor networks (WSNs) can be readily deployed in various environments to collect information in an autonomous manner, and thus can support abundant applications such as habitat monitoring [1],moving target tracking [2], and fire detection ,Most phenomena or events are spatially and temporally correlated, which imply data from adjacent sensors are often redundant and highly correlated. To exploit both spatial and temporal correlations, the data aggregation, which can be regarded as simple data fusion, is introduced by Heidemann et al. [9] to conduct some simple operation on raw data at intermediate nodes, such as MAX, MIN, AVG, SUM, etc., and then only the abstracted data are transmitted to the sink, and thus save energy consumption by avoiding redundant transmissions. Although the existing data aggregation schemes can effectively make packets more spatially and temporally convergent to improve aggregation efficiency, most of them assume that there are homogenous sensors and only one application in WSNs, It is impossible to conduct simple aggregation operations on the packets from heterogenous sensors even if all packets can be transmitted along the same reconstructed aggregation trees and timing control schemes can also ensure packets have a high probability to meet with each other. Even data fusion can merge multiple heterogenous raw data to produce new data, which is expected to be more informative and synthetic than input raw data, it is meaningless to make data fusion on raw data from different applications. The routing protocols employed by most of existing data aggregation schemes are Static. They properly support data aggregation in the network with Homogenous sensors and a single application, but cannot conduct effective data aggregation.

In this work, we introduce the concept of packet attribute, which is used to identify the packets from different applications or heterogenous sensors according to specific requirements, then design an attribute-aware data aggregation(ADA) scheme, which can make the packets with the same attribute convergent as much as possible to improve the efficiency of data aggregation. A distributed and dynamic routing protocol is expected to adapt to the frequent variation of packet attribute distribution at each node.

II. Related work

In [29], Liu et al. proposed a poller/pollee-based architecture with the objective of minimizing the number of overall pollers while bounding the false alarm rate for the applications capable of monitoring the sensor statuses such as liveness, node density, and residue energy.

Wang et al. proposed a distributed multi cluster coding protocol [30] to partition the entire network into a set of coding clusters such that the global coding gain is maximized.

In [32], Park et al. combined the shortest path tree with the cluster method and developed a hybrid routing protocol to support data aggregation. Ahead node in each minimum dominating set performs data aggregation and all head nodes are connected by construction global shortest path tree.

Energy-aware distributed heuristic (EADAT)[13] and power-efficient data gathering and aggregation protocol (PEDAP) [14] are two typical examples of tree based data aggregation schemes. The main advantage of EADAT is that the node with higher residual energy has the higher probability to become non leaf tree node, and thus the network lifetime can be extended in terms of the number of alive nodes. PEDAP computes a minimum spanning tree using transmission overhead as the link cost, and thus minimizes the total energy consumption in each communication round. However, it is costly to reconstruct the spanning tree for each communication round.

In[18], a set of routes is pre constructed and one of them keeps active in round-robin fashion, which can save energy by avoiding reconstructing route and balance energy consumption. However, each node needs to maintain the predetermined path to guarantee successful transmissions. When the network topology changes due to energy exhaustion on some nodes, the route needs to be reconstructed and the topology information maintained by each node needs to be updated, which will introduce considerable overhead.

Zhang et al. proposed a dynamic convoy tree-based collaboration (DCTC) to reduce the overhead of tree reconstruction in event-based applications, such as detecting and tracking a mobile target [17]. DCTC assumes that each node knows the distance to events and the node near the center of events acts as the root to construct and maintain the aggregation tree dynamically. How to obtain the information of event location and distance is still an open issue, which also restricts the applicability of DCTC. In addition, most existing data aggregation scheme can properly work in Homogenous environment, i.e., identical sensor data or a single application, but rarely considers the impact of heterogeneity, including heterogenous sensors or different applications in the same WSN.

III. EXISTING SYSTEM

Most of the existing work [10], [11], [12], [13], [14], [15], [16], [17], [18], [19] mainly focuses on the development of an efficient routing mechanism for data aggregation. Although the existing data aggregation schemes can effectively make packets more spatially and temporally convergent to improve aggregation efficiency, most of them assume that there are homogenous sensors and only one application in WSNs, and ignore considering whether the packets really carry redundant and correlated information or not. The routing protocols employed by most of existing data aggregation schemes are static. They properly support data aggregation in the network with homogenous sensors and a single application, but cannot conduct effective data aggregation

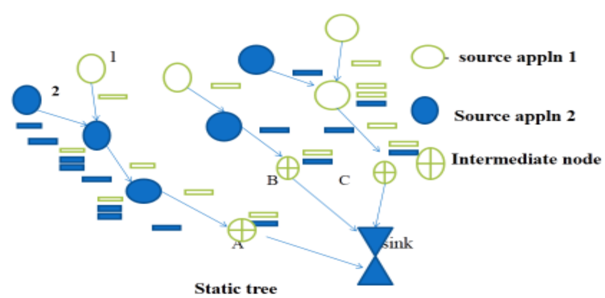

Fig. 1: System

IV. PROPOSED SYSTEM

The dynamic routing protocol is the corner stone of ADA suitable for heterogenous data or various applications in the same WSN. The concept of pheromone in ant colony [27] inspire us to design the dynamic routing algorithm for our ADA scheme. In nature, ants leave pheromone, which can emanate an odor and evaporate with time, along the paths that they have passed. The afterward ants will select their paths according to the amount of pheromone on different paths. If the packets in WSNs are treated as the ants in nature by analogy, and then the attribute-dependent pheromone is left on the nodes through which packets with different attribute pass. Subsequently, the node with different pheromone will emanate different odor. The more is the pheromone, the more intense is the odor. The packets just follow the odor to meet with other packets with the same attribute. In this way, the packets can be gathered together by intentional forwarding, which will assist in achieving the goal of our ADA scheme.

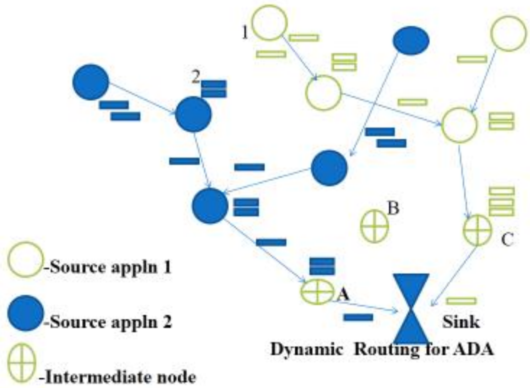

Fig. 2: System

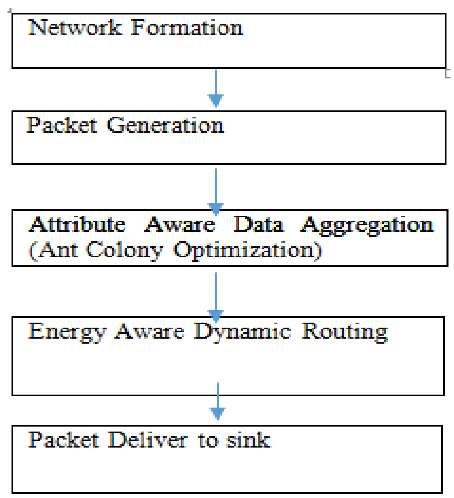

Fig. 3: flow diagram

A. Network Formation:

This module deals with creation of the N number of nodes that is mainly used in this project. The nodes are created dynamically according to the query type required by the sink node. Each node has unique ID and the node type. While creating a node, the details about neighbor nodes are stored. Given wireless sensor network nodes current capabilities, we set out to design a data collection network that would meet the scientific requirements. Before deploying network we are going to collect sensor node details. Based on that network is formed.

B. Packet Generation:

Sensor nodes will sense the information from the environment and stores the information as a data files in a network node, in which they were embedded. Sensor nodes can be used for different kind of application purpose. In our simulation heterogeneous sensor like humidity sensor, temperature sensor and pressure sensors were used, which are also used to sense the remote environment. In networking environment transmitting data files through network is not a recommended way to process. If we transmit files in a network means they may generate lot of traffic and also gives bourdon on server. So here we are generating packets and using the network environment without any data collision.

C. Attribute Aware Data Aggregation (Ant Colony Optimization):

This scheme use the concept of packet attributes which is used as an identifier of the data packets generated from various sensor nodes. By this scheme attribute Id is assigned for each data packets. By this attribute ID data packets of same files were grouped together. In fact, the simplest way to aggregate data flowing from the sources to the sink is to elect some special nodes that work as aggregation points and define a preferred direction to be followed when forwarding data. In the approach based on tree [6, 7], a tree structure is constructed first and is later used to either route data collected or respond to queries generated by the sink. The aggregation is performed during the routing, when two or more data packets arrive at the same node of the tree. This node aggregates the data and forwards only one packet with the aggregated data.

D. Dynamic Routing:
Route was found by using attribute aware aggregation algorithm. First source node was selected. For that node set of neighbors found. From that neighbor next forwarding node is the node that has same attribute as current forwarding node. This process was continued until reaching the sensor node. Finally data was transferred though that path.

E. Packet Deliver to Sink:
More number of abstracted data sends to sink based on attribute aware data aggregation.

F. Approaches For Packet Driven Timing Control Algorithm:
To adapt to our dynamic routing protocol and overcome the drawbacks in existing timing schemes, we propose a packet-driven adaptive timing scheme. The node maintains a timer for the packets with the same attribute in its queue. When the timer fires, the corresponding aggregation is performed. When receiving one new packet, the value of timer is initialized or updated dynamically.

This algorithm to avoid excessive packet dropping. The timing control algorithm for our ADA is packet driven and adaptive.

G. Result:
1) *Node creation with energy generation:*

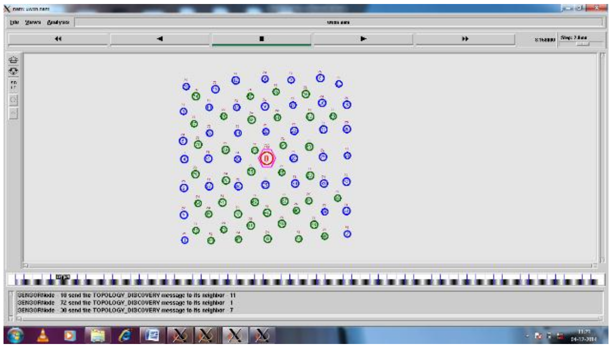

Fig. 4: Node creation with energy generation

2) *Packet generation:*

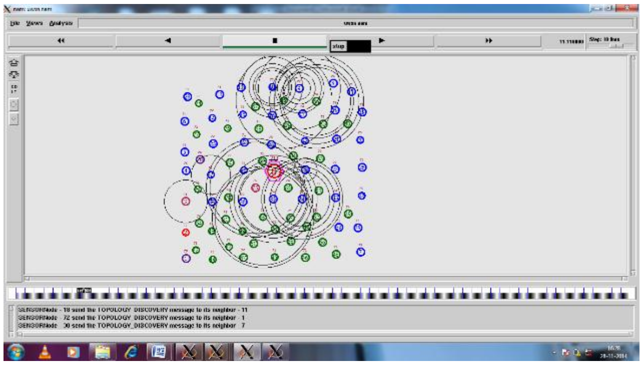

Fig. 5: Packet generation

3) *Packet deliver to sink:*

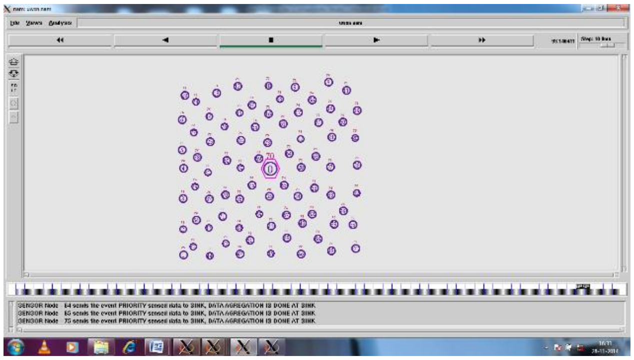

Fig. 6: Packet delivers to sink

4) *Performance analysis:*
   – Packet delivery ratio

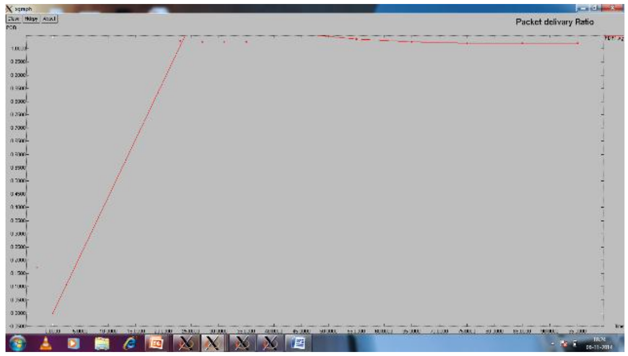

Fig. 7: Packet delivery ratio

V. CONCLUSION

The data aggregation is an effective mechanism to save limited energy in WSNs. Heterogenous sensors and various applications likely run in the same network. To handle this heterogeneity, in this paper, we introduce the concept of packet attribute and an attribute-ware data aggregation scheme consisting of PBDR protocol and packet-driven timing control algorithm. Packets are treated as ants, and then the basic mechanism for finding paths based on pheromone in ant colony is borrowed to attract the packets with the same attribute spatially convergent as much as possible, and therefore improve the efficiency of data aggregation.

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