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Potential-Based Dynamic Routing in Wireless Sensor Networks Data Gathering

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ABSTRACT: In wireless sensors the data can be send through network without any data collusions. Here, we are transmitting the data in the form of encrypted packets through network to destination without any misplacement of data packets .To fulfilling that, data aggregation is used. Data aggregation has been widely recognized as an efficient method to reduce energy consumption in wireless sensor networks, which can support a wide range of applications such as monitoring temperature, humidity, level, speed etc. The data sampled by the same kind of sensors have much redundancy since the sensor nodes are usually quite dense in wireless sensor networks. To make data aggregation more efficient, the packets with the same attribute, defined as the identifier of different data sampled by different sensors such as temperature sensors, humidity sensors, etc., should be gathered together. However, to recognize that the present data aggregation mechanisms did not take packet attribute into consideration.

In this paper, we take the lead in introducing packet attribute into data aggregation and propose an Attribute-aware Data Aggregation mechanism using Dynamic Routing (ADADR) which can make packets with the same attribute convergent as much as possible and therefore improve the efficiency of data aggregation.

I.INTRODUCTION

Wireless Sensor Networks (WSNs) can be readily deployed in various environments to collect information in an autonomous manner. It can support various applications such as habitate monitoring [1], fire detection [2], identifying data fusion [3], and moving target tracking [4].The collaborative signal processing algorithms can be designed in WSN applications to improve the sensing performance.

A data fusion technique, which can merge raw data from multiple sources to achieve improved accuracies and more specific inferences than could be achieved by use of a single sensor alone [4], has been employed in sensor network systems for target detection [5], [6], localization [7], and classification [8].Generally, data fusion involves hierarchical transformation between sensory raw data and decision, which constitutes statistical and sequential estimations, or weighted decision problems [4]. Thus, data fusion often requires intensive computing, which may be unaffordable for the nodes in WSN with the limited resources including computing, storage and especially energy, which is usually difficult to be supplemented due to unattended operation in remote or even hostile locations. Hence, it is a key research issue to design energy efficient protocol for WSNs. The phenomena or events in most that 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. Following this paradigm, numerous data aggregation schemes [8],[9],[10],[11],[12]. Proposed to save the limited energy on sensor nodes in WSNs.

In wireless sensor network community, the investigations mostly on data aggregation schemes focus on designing proper strategies to drive the packets carrying redundant and correlated data converge spatially and temporally, which will provide more chances and more sufficient conditions for actual aggregation operations. Accordingly, the data aggregation schemes can broadly classified into temporal and spatial solutions.

The work in [8], [9], [10], [11], [12], focus on efficient routing mechanism for data aggregation. Although the existing data aggregation schemes can make packets more spatially and temporally convergent to improve aggregation efficiency, most of them assume that there are homogeneous sensors and only one application in WSNs, and ignore considering whether the packets really carry redundant and correlated information or not. Actually, nodes are equipped with various sensors (i.e., pressure, temperature, humidity, light intensity, etc.) and different applications can also run in the same WSN simultaneously. It is impossible to conduct simple aggregation operations on the packets from heterogenous sensors even if all packets can be transmitted along the same preconstructed 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.

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 using dynamic routing scheme (ADADR) scheme, which can make the packets with the same attribute convergent as much as possible to improve the efficiency of data aggregation. The routing protocols employed by most of existing data aggregation schemes are static. They properly support data aggregation in the network with homogeneous sensors and a single application, but cannot conduct effective data aggregation when the data from heterogenous sensors or various applications are forwarded along the same static path. Events always occur randomly in time and space, the information of packet attribute at each node is hardly predicted. It is costly to predetermine the proper routing path for each packet attribute. Therefore, a distributed and dynamic routing protocol is expected to adapt to the frequent variation of packet attribute distribution at each node. By the concept of *pheromone*, which will be left along the path where ants pass and evaporate with time, in ant colony [12], we draw an analogy between pheromone and packet attribute.

A packet will leave attribute-dependent pheromone when passing a node to attract the afterward packets with the same attribute, which will make the packets generated by the same applications more spatially convergent. With respect to routing decisions, we borrow the concept of potential in physics and follow the potential-based routing paradigm in the context of traditional networks to develop a dynamic routing algorithm. The packets are driven by a hybrid virtual potential field to move toward the sink, at the same time the packets with identical attribute are attracted by attribute-dependent pheromone to move along the same path, which will provide more chances to conduct data aggregation effectively. In addition, the potential-based routing is scalable and easy to be implemented since only local information are required and can be easily obtained. To further improve the performance of data aggregation scheme, the packets should also be temporally convergent so as to meet with each other at the same node as well as at the same time. Thus, we also design an adaptive packet driven timing control algorithm to improve temporal convergence. In summary, the main contributions in this work are threefold:

- An ADA scheme is proposed to intentionally drive the packets with the same attribute convergent as much as possible in the WSNs with heterogenous sensors or various applications.
- Inspired by the concepts of both potential field in physics and pheromone in ant colony, a dynamic routing protocol is elaborately designed to support the ADA scheme.
- An adaptive packet-driven timing control algorithm is proposed to provide more chances for data aggregation on nodes.

The remainder of the paper is organized as follows: Related work and motivation are introduced in next section. In Section 3, the details of ADA, including the potential based dynamic routing (PBDR) and the packet-driven timing scheme, are presented. In Section 4.2, the simulations are conducted to evaluate the performance of our ADA mechanism.

2. DESIGNING ADADR

In this section, the PBDR protocol will be presented, followed with some analysis of key parameters, then a packet-driven timing scheme which cooperates with the dynamic routing will be developed. For a legible description, we first introduce some definitions

2.1. Definition

Depth: The depth of a node is the number of hops that it is away from the sink. Neighbor: The neighbor of node i is all nodes in the radio coverage disk of node i except for i itself, denoted by sigma.

Attribute: The attribute of data packet is its identification. The heterogenous sensors and nodes involved in different applications may generate data packets with different attributes. The identical sensors on the nodes involved in the same applications will generate the packets with identical attribute. We use different natural numbers to identify different attributes, and extend the packet header to carry this value.

2.2. PBDR

Intuitively, it is just like the valleys in the surface of the bowl .The more intense are the odor, the deeper is the valley. Each packet will select the deepest valley with the same odor as that of itself as the path to the sink rather than flow along a fixed path such as the shortest path to the sink. In Potential based dynamic routing (PBDR), the heterogeneous sensors and nodes involved in different applications may generate data packets with different attribute. The more intense is the odor, the deeper is the valley. Each packet is transmitted to the deepest valley with the same odor as that of itself, rather than be sent along a fixed path such as the shortest tree. In this way, the packets with the same attribute can intentionally follow the same path and converge as much as possible.

2.3. Ant colony mechanism

An ant is a simple computational agent in the ant colony optimization algorithm. It iteratively constructs a solution for the problem at hand. The intermediate solutions are referred to as solution states. At each iteration of the algorithm, each ant moves from a state x to state y, corresponding to a more complete intermediate solution. Thus, each ant K computes a set $A_K(x)$ of feasible expansions to its current state in each iteration, and moves to one of these in probability. For ant K, the probability p^k_{xy} of moving from state x to state y depends on the combination of two values, viz., the *attractiveness* η_{xy} of the move, as computed by some heuristic indicating the *a priori* desirability of that move and the *trail level* τ_{xy} of the move, indicating how proficient it has been in the past to make that particular move.

The *trail level* represents a posteriori indication of the desirability of that move. Trails are updated usually when all ants have completed their solution, increasing or decreasing the level of trails corresponding to moves that were part of "good" or "bad" solutions, respectively.

In general, the Kth ant moves from state x to state y with probability

$$p^k_{xy} = \frac{(\tau^{\alpha}_{xy})(\eta^{\beta}_{xy})}{\sum_{y \in \mathrm{allowed}_y}(\tau^{\alpha}_{xy})(\eta^{\beta}_{xy})}$$

Where τ_{xy} is the amount of pheromone deposited for transition from state x to y, $0 \leq \alpha$ is a parameter to control the influence of τ_{xy}, η_{xy} is the desirability of state transition xy (*a priori* knowledge, typically $1/d_{xy}$, where d is the distance) and $\beta \geq 1$ is a parameter to control the influence of τ_{xy}. η_{xy} and η_{xy} represent the attractiveness and trail level for the other possible state transitions.

III.EXPERIMENTAL SETUP

We implement the ADA scheme in nes C and use the TOSSIM simulator integrated in Tiny OS to evaluate its performance. Assume that an aggregation function can merge the packets with correlated information into one packet regardless of its actual operators. This assumption can be held for some common aggregation operators, such as MAX, MIN, SUM, AVG, STD, and VAR.

The other particular parameters in different scenarios will be introduced in the related sections. A randomly deployed network with three circular monitoring areas. With regard to the setting of parameters α, ρ, and S, we set S=32, $\rho = 0.9$, and $\alpha = 0.78$. A relatively large ρ indicates that the pheromone evaporates more slowly, which is propitious to make the packets with identical attribute be transmitted along the same path to the sink. Otherwise, in our simulations, three different scenarios where node density and scale vary, respectively, and a mobile event is introduced, are designed to conduct a comprehensive performance evaluation and comparison with the following typical schemes: SPT: Packets are forwarded to the sink along the shortest path. Aggregation is opportunistic and happens only if two packets with the same

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attribute encounter at the identical node as well as at the same instant. . CT: The shortest path tree with CT scheme proposed

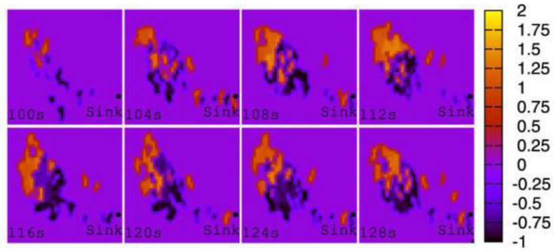


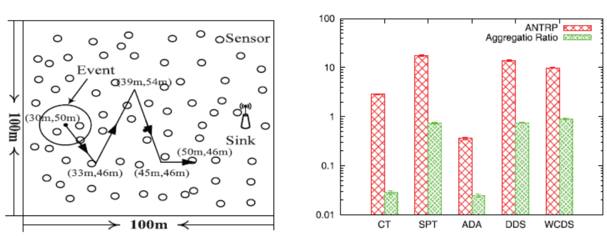
Fig. 1. Snapshot of normalized queue length in ADA.

DDS: A special dominating set is constructed first and then a connected dominating set is constructed to connect dominators and the other nodes, and the resultant tree can act as the aggregation tree. WCDS: A directed tree over the sensor network nodes is constructed to compress the value of a node using the value of its parent. To the best of our knowledge, little work focuses on the data aggregation in WSN with heterogenous sensor and various applications. Actually, in the homogeneous environment, our ADA scheme should have advantage over the existing data aggregation scheme employing the static routing protocol.

To verify this prediction, the above four schemes are chosen to make comparison with the ADA scheme. It is noted that the DDS only provides an aggregation tree. To make proper comparison, the adaptive timing control scheme presented in this work is combined with the aggregation tree of DDS in simulation experiments.

IV.RESULTS AND DISCUSSION

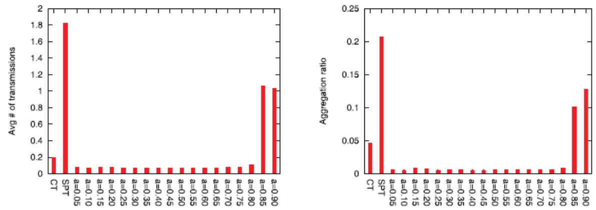
To evaluate the performance of ADA in mobile scenario, we configure an event moving at the speed of 0.1m/sec in a 100 mx100 m WSN with 100 sensors as shown in Fig. 2a. The radius of the circle is 4 m. The event starts to move from (30m,50m) and stops at (50m,46m), and the moving trajectory is also depicted in Fig. 2a. The experiment is repeated 10 times and the statistical results are calculated. Both ANTRP and AR are presented in Fig. 2b.



(a) Moving events (b) Statistical results

Fig.2. Mobile scenarios

The average number of transmissions per received packet and AR of ADA is the smallest among all schemes. The obvious advantage of the dynamic routing protocol and adaptive timing control scheme in ADA implies that it is critical to dynamically forward packets in response to the state of both network and event in mobile scenario.



(a) ANTRP (b) Aggregation Ratio

Fig.3. Different parameter α

Specifically, in Fig. 2a, the event moves along a curve. ADA can dynamically send packets along the curve to make packets more convergent in space. However, the static routing protocol employed by most existing data aggregation schemes only send packets along the predetermined route path. Although the AR of ADA is nearly same as that of CT, the average number of transmissions per received packet in CT is much larger. The reason is that although most of packets are aggregated in CT, they are aggregated much later than that in ADA. Hence, ANTRP is relatively large. The obvious advantage is obtained by our ADA scheme; moreover, it does not need any extra mechanisms to monitor or maintain necessary information for dynamic routing, such as event locations required by the dynamic routing in [11]. In addition, the small standard deviation presented by bars in Fig. 2a shows that our proposed scheme is stable.

VI.CONCLUSION

The data aggregation is an effective mechanism to save limited energy in WSNs. Heterogeneous sensors and various applications likely run in the same network. To handle this heterogeneity, in this paper, we introduce the concept of packet attribute to identify different packets generated by heterogeneous sensors and different applications, and then propose 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 to gather together. Enlightened by the concept of potential in physics, a PBDR protocol is developed.

REFERENCES

[1] R. Szewczyk, A. Mainwaring, J. Polaster, and D. Culler, "An Analysis of a Large Scale Habitat Monitoring Application," Proc. ACM Int'l Conf. Embedded Networked Sensor Systems
(SenSys), 2004.
[2] M. Hefeeda and M. Bagheri, "Forest Fire Modeling and Early Detection Using Wireless Sensor Networks," Ad Hoc and Sensor Wireless Networks, vol. 7, nos. 3/4, pp. 169-224, Apr. 2009.
[3] Q. Fang, F. Zhao, and L. Guibas, "Lightweight Sensing and Communication Protocols for Target Enumeration and Aggregation," Proc. Fourth Int'l ACM Symp. Mobile Ad Hoc Networking and Computing, 2003.
[4] D.L. Hall and J. Llinas, "An Introduction to Multisensor Data Fusion," Proc. IEEE, vol. 85, no. 1, pp. 6-23, Jan. 1997.
[5] D. Li, K. Wong, Y.H. Hu, and A. Sayeed, "Detection, Classification and Tracking of Targets in Distributed Sensor Networks," IEEE Signal Processing Magazine, vol. 19, no. 2, pp. 17-29, Mar. 2002.
[6] T. Clouqueur, K.K. Saluja, and P. Ramanathan, "Fault Tolerance in Collaborative Sensor Networks for Target Detection," IEEE Trans. Computer, vol. 53, no. 2, pp. 320-333, Mar. 2004.
[7] X. Sheng and Y.H. Hu, "Energy Based Acoustic Source Localization," Proc. IEEE Int'l Conf. Information Processing in Sensor Networks, pp. 285-300, 2003.
[8] M. Ding, X. Cheng, and G. Xue, "Aggregation Tree Construction in Sensor Networks," Proc. IEEE 58th Vehicular Technology Conf.pp. 2168-2172, Oct. 2003.
[9] H.O. Tan and I. Korpeoglu, "Power Efficient Data Gathering and Aggregation in Wireless Sensor Networks," SIGMOD Record, vol. 32, no. 4, pp. 66-71, Dec. 2003.
[10] J. Li, A. Deshpande, and S. Khuller, "On Computing Compression Trees for Data Collection in Wireless Sensor Networks," Proc. IEEE INFOCOM, 2010.
[11] W. Zhang and G. Cao, "DCTC: Dynamic Convoy Tree-based Collaboration for Target Tracking in Sensor Networks," Ad Hoc and Sensor Wireless Networks, vol. 3, pp. 1689-1701, Sept. 2004.

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