National Conference on Recent Research in Engineering and Technology (NCRRET-2015)
International Journal of Advance Engineering and Research Development (IJAERD)
e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

Location-Based Routing Protocols for Wireless Sensor Network: A Survey

Mayur Ajmeri[*1], Mamta Parmar[#2]
* *Assistant Professor* in CSE Department, DJMIT, Gujarat, India. mayurajmeri@gmail.com
# *Assistant Professor* in CSE Department, DJMIT, Gujarat, India. mamtaparmar32@gmail.com

Abstract: *Mobile sink node properly used in routing protocols can improve network performance. Thus we investigate location-based routing protocols. The latter strategy can be further classified into backbone-based and rendezvous-based routing protocols. We first describe the main principles of the two location-based routing protocols with sink mobility support respectively. Then we analyze their advantages and disadvantages.*

Keywords: wireless sensor networks, mobile sink, routing, backbone-based, and rendezvous-based.

I. Introduction

In a typical wireless sensor network (WSN), sensor nodes are usually powered with limited batteries which may cause hot spot problem by unbalanced energy consumption. Network lifetime is subject to those hot spot sensors near sink nodes. Especially in a static WSN, sensor nodes close to the sink node will have more traffic to forward and they tend to deplete their energy much quickly than other sensors which are far away from sink [1-3].

To alleviate the hot spot problem, adopting sink mobility technology is an effective way. As the movement of sink node, peripheral neighbor node is also changing, and energy consumption can get balanced among sensor nodes. Besides, the whole network energy consumption can get reduced with relatively shorter transmission distance between sensor and sink, if sink mobility pattern is well designed.

The main contributions in this paper are as follows. We investigate location-based routing protocols. The latter strategy can be further classified into backbone-based and rendezvous-based routing protocols. We first describe the main principles of the two location-based routing protocols with sink mobility support respectively. Then we analyze their advantages and disadvantages.

II. Sink Mobility Pattern

Most existing work is related to the data dissemination applications [4-6], where sink will employ one of the following three mobility patterns, namely random mobility, predictable mobility, and controlled mobility. The first sink mobility pattern is called random mobility which is easy to implement. When sink node moves randomly, it is not necessary to acquire the network information like sensor residual energy to determine the next sink sojourn position. The movement trajectory of mobile sink node is also random since the sojourn positions are randomly decided. The second sink mobility pattern is called predictable mobility. In sensor networks where moving path is predictable, sink nodes can carry the moving trajectory information as they move around. By exploiting predictable sink mobility technology, mobile sink nodes can be installed on some periodically moving vehicles such as public buses which usually move along some pre-determined fixed paths. The last sink mobility pattern is called

controlled mobility. In sensor networks where moving path is controllable, sink sojourn positions can be determined based on network information like sensor residual energy and distance. The sink moving pattern can then adapt to various network conditions very well.

III. Location-based Routing Strategies Supporting Sink Mobility

A) Backbone-based routing protocols:

To offer data dissemination with low energy consumption, dynamic directed backbone (DDB) protocol [7] is built on top of the low energy self-organization scheme. A non-directed backbone is built by localized self-organization scheme. The initiate message of sink nodes can be sent through this backbone to all sensor nodes. In self-organized backbone construction process, only a set of sensor nodes will be chosen to send neighboring information. These sensors are defined as leader nodes which are interconnected by gateways. When a sensor joins in the network, it will decide whether to be a leader node or not based on local organization. In the process of dynamic directed backbone construction, a query message will be injected into the network once a sink node arrives. The query message will be translated by sensor nodes which capture it. Corresponding information propagation will be guided by the self-organized backbone. A mobile routing algorithm with registering (MRAR) in cluster-based architecture [8] is proposed to minimize the energy consumption while maintain certain network lifetime. Each sensor needs to establish a neighbor information table in order to hold the information about geographical address and the status of energy supply. Nodes with higher energy will be chosen as cluster heads. After completing the formation of clusters, sink node will move around in the network according to those calculated random waypoints, and send out messages.

Comparison of the above backbone-based routing protocols with mobile sink support is summarized in Table 1.

Table 1. Comparison of the two backbone-based routing protocols

Protocols	**Structure**	**Characteristics**	**Limitations**
DDB[7]	Backbone	1.Self-organization scheme;	1.Lack of comparison of data dissemination using different backbone strategies;
		2. Directed dissemination structure;	2.To provide low energy transmission in data dissemination;
		3. To reduce data traffic;	
		4.To be extended to mobile sink and multi-sink scenarios;	
MRAR [8]	Clusters	1.To eliminate complicated computation upon operation;	1.The delay of data disseminations;
		2.To reduce energy consumption while	2. Only consider the situation existing

		prolonging network lifetime;	one mobile sink node.
		3.To decrease relay frequency of sensor nodes nearby sink ;	

B) **Rendezvous-based Routing Protocols:**

A geographic hash table (GHT) system is described for data-centric storage in [9]. GHT protocol can be easily adopted in WSNs using mobile sink nodes, even though it is not specially designed for mobile networks. In GHT, hashing of a key into geographic coordinates is the critical step. The selection of an appropriate sensor node or home node storing the key-value pair is central to building GHT. Stored data will be replicated locally to ensure persistence when a sensor node fails. However if there is a clustered failure, localized replication is of little use. A two-tier data dissemination protocol (TTDD) [10] using multiple sink nodes is proposed to provide network scalable. A grid infrastructure is adopted and only the sensors located in the grid points need to acquire forwarding information. Each source node will proactively construct a grid structure, and chooses itself as the start crossing point of the gird. Data notification is sent to the four adjacent crossing points until reaching the next sensor node closest to the crossing point by greedy geographical forwarding. Queries from sink nodes can be propagated along the grid until reaching the source node. A line-based data dissemination (LBDD) protocol [11] supporting unpredictable mobile sink nodes is proposed to offer good network scalability. In LBDD, the whole sensor network is divided into two equal parts by a vertical line. Sensor nodes within the boundaries of this vertical line are defined as inline-nodes. The core part of this protocol is the concept of a rendezvous region which decouples data dissemination operation. Therein, the vertical line acts as the rendezvous region, and it is located at the center of the sensing field.

An overview and comparison of the above routing protocols with mobile sink support is summarized in Table 2.

Table 2. Comparison of the three rendezvous-based routing protocols.

Protocols	**Structure**	**Characteristics**	**Limitations**
GHT[9]	Hashed location	1. Data-centric storage;	1.Non-uniform distribution of senor nodes;
		Hashing keys;	2.Geographic boundaries;
		2.Keys are uniformly hashed;	3.To use only approximate geographic information;
		3.To offer robust persistence and high data availability	4.High node burden;
TTDD [10]	Grid-based	1.Scalable,and location-aware;	1.Each source node needs to

			construct a grid structure;
		2.Efficient data delivery;	2.Reuse of grid structure;
		3.To reduce energy consumption and network overload;	
LBDD [11]	Line/strip	1.To address hot spot problem, and be suitable for event-driven and query-based scenarios;	1.Sparse network;
		2. To provide good trade-off;	2.Data persistence against node failure;
			3.Malicious nodes inside the virtual infrastructure;

IV. Conclusion

Sink mobility technology as an effective method to improve sensor network performance has drawn much research attention recently. Based on different sink mobility patterns and routing algorithms, various location-based routing strategies with mobile sink support can be applied to collect interested data from source nodes for WSNs. In this paper, the backbone-based and rendezvous-based routing strategy has been surveyed, and some comparisons are provided. If routing strategies are carefully designed in align with proper routing algorithms. Mobile sink node properly used in routing protocols can provide better network performance.

References

1. Akyildiz, I., Su, W., Sankarasubramaniam, Y., Cayirci, E.: Wireless sensor networks: a survey, Compute Network, 2002, 38, 393-422.
2. Shah, R., Roy, S., Jain, S., and Brunette, W.: Data MULEs: modeling a three-tier architecture for sparse sensor network, Ad Hoc Networks, September 2003, 1, 215-233.
3. Heinzelman, W., Chandrakasan, A. and Balakrishnan, H.: Energy-efficient communication protocol for wireless sensor networks. Proceeding of the 33rd Annual Hawaii International Conference on System Sciences, Cambridge, MA, USA, January 2000.
4. Chakrabarti, A., Sabharwal, A., and Aazhang, B.: Communication power optimization in a sensor network with a path-constrained mobile observer, ACM Trans. Sensor Networks, August 2006, 2, 297-324.
5. Al-Karaki, J.N., and Kamal, A.: Routing techniques in wireless sensor networks: a survey, IEEE Wireless Communications, December 2004, 11, 6-28.
6. Lambrou, T., and Panayiotou, C.: A survey on routing technique supporting mobility in sensor networks, 5th International Conference on Mobile Ad-Hoc and Sensor Networks, Fujian, December 2009,78-85
7. Lu, J.L., and Valois, F.: On the data dissemination in WSNs, IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, White Plains, NY , October 2007, 6-8.

8. Wang, Y., Huang, K., Fu, P., and Wang, J.: Mobile sink routing protocol with registering in cluster-based wireless sensor networks, Ubiquitous Intelligence and computing, 2008, 5061, 352-362.
9. Ratnasamy, S., Karp, B., Shenker, S., Estrin, D., Govindan, R., Yin, L., and Yu, F.: Data-centric storage in sensornets with GHT, a geographic hash table, Mobile Networks and Applications, August 2003, 8, 427-442.
10. Luo, H., Cheng, J., Lu, S., and Zhang, L.: TTDD: two-tier data dissemination in large-scale wireless sensor networks, Wireless Networks, January 2005, 11, 161-175.
11. Hamida, E.B., and Chelius, G.: A line-based data dissemination protocol for wireless sensor networks with mobile sink, IEEE International Conference on Communication, Beijing, May 2008, 2201-2205.