Mobile Relay as Doze Node for Conserving Energy in WSN

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***Abstract*— A wireless sensor network (WSN) consists of a large number of sensor nodes which are deployed over the geographical area. Sensor nodes monitors surrounding environmental phenomenon, processes this data obtained and forward this data towards a base station located on the periphery of the sensor network. Each node in the network is equipped with a battery, but it is almost very difficult to change or recharge batteries. Hence in order to maximize lifetime of the network the energy consumed by the node should be minimized.**

The existing scheme uses Power-Aware Relay Selection (PARS) strategies to maximize the network lifetime. The PARS minimizes the overall transmit power and helps to select the best relay among all the relays such that the selected relay can extend lifetime of the network. However the relaying in the existing scheme is static which may give rise to usage of large number of relay nodes, which leads to larger power consumption in the overall network. Hence this project work proposes Relative Power Adaptable Distance Aware Routing for the less energy consumption. The relay in the proposed scheme is mobile whereas the user and Base station is assumed to be static. Therefore the energy consumption for each node and also the number of relay nodes gets decreased because of using mobile relay nodes and hence the network lifetime gets enhanced. But most of the energy is consumed when the radios are on, waiting for an arrival to occur. However, the relay in this scheme will be in active state every time even it does not receive any message from the source. We are interested in minimizing the delay and maximizing the lifetime of wireless sensor networks. Therefore we compare one more concept as considering mobile relay as doze nodes to reduce the energy consumption in order to maximize the network lifetime. Performance metrics like delay, throughput, packet loss, and energy consumption have been compared between existing and the proposed schemes.

***Index Terms*—BS, RS ,MS, PARS, Wireless Sensor Network**

I. INTRODUCTION

WIRELESS sensor networks (WSNs) are an important technology that can enhance our capability of monitoring and interacting with the physical world. The development of wireless sensor networks was originally motivated by military applications. However, wireless sensor networks are now used in many civilian application areas. A WSN consists of a set of sensors that are interconnected by a communication network. The sensors are deeply embedded devices that are integrated with a physical environment and capable of acquiring signals, processing the signals, communicating and performing simple computation tasks.

Each sensor network node has several parts such as a radio transceiver, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source. The efficient usage of energy is a critical issue in wireless sensor networks. There are many causes which lead to depletion of wireless sensor batteries which ultimately leads to failure of the network. When the distance between the base station and sink is larger than the transmission range means sensor node cannot send data directly to the sink then there is need for relay node placement. Originally, relay station is introduced in the next generation network due to enhancing network coverage and improving boundary capacity. But the energy consumption in relay system is still severe. The energy-efficiency problem in the relay system is more complex comparing with the network without RSs, and it becomes a focus of the current research.

Recent work showed that the energy consumption of WSNs can be significantly reduced by using the mobility of nodes. This paper proposes a new sensing model, the "mobile relay node" sensing model, where nodes that transmit data are physically detached from nodes that collect data. More specifically, relay nodes that roam around the area receive data from fixed sensors and transmit them to sink. In this paper, we use doze mobile relay nodes to reduce the total energy consumption of data intensive wireless sensor networks. Different from mobile base station or data mules or mobile relays, doze mobile relays do not always active; instead, they go to sleeping mode, while there is no noticeable change in the signal level.

II. RELATED WORK

In [1,2] joint sub channel and power allocation problems were studied in OFDMA relay cellular networks where RSs can perform network coding with downlink as well as uplink sessions of an MS. However, they did not consider a practical duplexing scheme for the transmission of data where the network coding is applied. Network coding is a simple extension of routing that allows for any node in the network to perform operations on its received data before it transmits any data. It is an elegant technique introduced to improve network throughput and performance [3],[4],[5], [6].The practical XOR coding scheme [7] demonstrates throughput

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enhancement in 802.11 networks uses a single common frequency.

A mobile base station moves around the network and collects data from the nodes. All nodes are always performing multiple hop transmissions to the base station, and the aim is to rotate which nodes are nearer to the base station in order to balance the transmission load [8], [9], [10]. In other work, nodes only transmit to the base station when it is close to them. The goal is to calculate a mobility path to collect data from visited nodes previous to those nodes suffer buffer overflows [11], [12], [13], [14].

Data mules are similar as mobile base stations [15], [16], [17]. They collect data from the nodes and deliver it to the sink. In [18], the data mule visits all the sources to pick up data, transports data over few distance, and then send it to the static base station through the network. The aim is to find a movement path that minimizes both communication and mobility energy conservation .Similar to mobile base stations, data mules produces more delays since sensors have to wait for a mule to pass by priory starting their transmission.

The network consists of mobile relay nodes together with static base station and data sources. Normally relay nodes transport data. Mobile relay nodes are same as static relay node but mobile relay node move to different locations to decrease the transmission costs. Hence in our work we use the mobile relay in this work. In [22], if the movement is beneficial then only the mobile nodes move, but only the position assumed is the midpoint of neighbors. Many papers have considered the use of mobile relays to alleviate the problem that nodes nearer to a base station tend to quickly deplete their energy [20, 21,22].

III. EXISTING METHOD

All the sensors are static and then the network is considered as static network. The Base station forwards the data to the user through relay

In this work, a static network contains single base station with two relay station and number of users. Relays station operates on unidirectional routing and Xor network coding concept is applied to relay station.

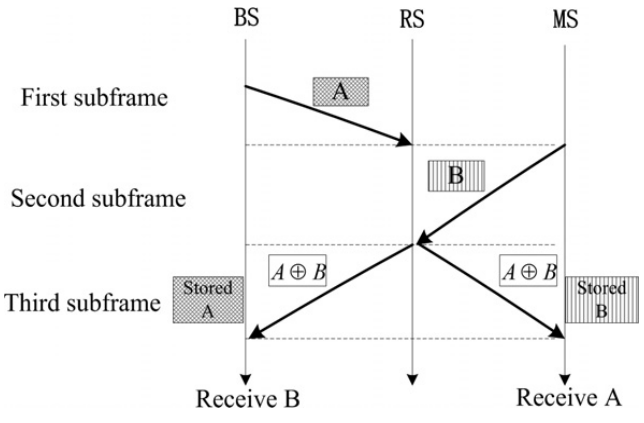

Fig.1.Network Coding Process in RS

A. *POWER AWARE RELAY SELECTION ALGORITHM*

In a typical network, the route of a packet will be determined by calculating which path is either fastest, or has the least amount of hops. This may mean that some nodes in the network get far ~~more usage~~ than others. If nodes have a limited power supply, such as laptop, extreme usage could quickly drain the battery. A temporary mobile network, such as an ad hoc network, would benefit from Power Aware Routing. When you can adjust the transmission power of nodes, hop count may be replaced by consumption metrics .A node sends out a control message at a set power. Other nodes can determine the distance of the sending node based on the strength of the signal. Messages will typically be sent through a series of 'shortest hops' until it reaches its destination. This is done to minimize the energy expended by any single node. This method helps to find the most power efficient path of transmission.

The receiver power on a subcarrier for supporting b bits per symbol is given as

$$Rx(b) = \frac{N_0}{3}\left[Q^{-1}\left(\frac{p_e}{4}\right)\right]\wedge 2$$

The Transmission power on a subcarrier is given by

$$TX(b) = \frac{Rx(b)}{H_{k,n}}$$

Power utilized by single relay is given as

$$P_{relay} = \sum_{n=1}^{6} p_r(n)$$

Total energy consumed by relays in the network is given as

$$p_{total} = \sum_{r=1}^{n} p_{relay}(r)$$

Xor network coding is performed in the relay. The packet from the base station is received by the relay station and performs Xor operation and then it forwards to the particular user. Therefore decode and forward method is applied in relay station. The total energy utilized by a relay in a network and the delay performance is calculated.

IV. PROPOSED METHOD

Here we proposed two methods 1.Network consist of mobile relay and implementing in Relative power adaptable and distance aware routing algorithm. 2. similar to the method 1 But here we consider mobile relay as doze node.

Here low-cost disposable mobile relays to reduce the

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total energy consumption of data intensive WSNs. Not like mobile base station or data mules, mobile relays do not send data; instead, they move to various locations and then remain stationary to forward data along the paths from the sources to the base station. In mobile nodes decide to move only when moving is beneficial.

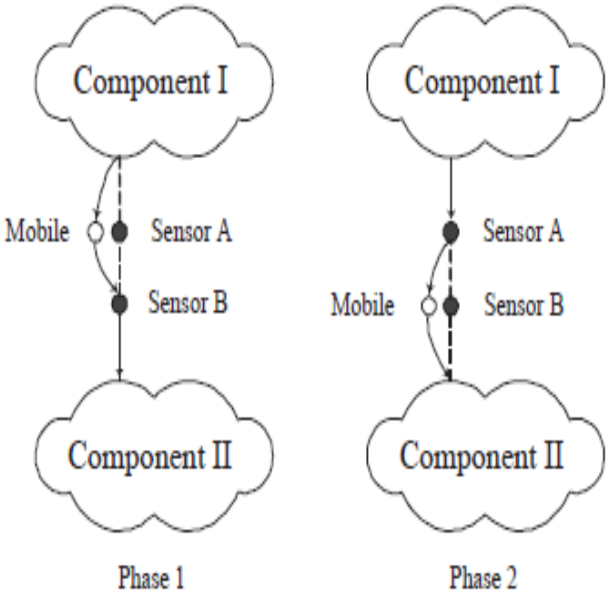

Fig .2.Static Relay Vs Mobile Relay

Figure 2 shows a sample network, where the use of mobile nodes as relays can significantly improve the lifetime of the network. Suppose that the network is composed of two components which are connected via two sensor nodes A and B. Assume that these are the critical bottleneck nodes in the network and the lifetime of these two nodes is T, while other sensors have lifetime much longer than T. If we have one mobile node with the same transmission range and reception range as the sensor nodes, then the network lifetime can be at least doubled. A simple algorithm for this would be for the mobile node to shuttle between node A and node B and inherit the responsibilities of the node with which it is co-located. It is clear that with an appropriate shuttling schedule, the network lifetime can be doubled to 2T. We assume here that the energy resource at the mobile node is far greater than that of any of the sensing nodes.

A. *FIRST METHOD*

The network consists of single base station along with one mobile relay nodes and number of users. Relay can be connected to two nodes. Based on the mobility relay is selected. Consider two relay namely A and B. If the mobility of relay A is lesser than the mobility of relay B. Then the relay A is selected. Receive and forward method is used and bidirectional routing is applied.

Let as take the relay node as i. Then the mobility of the relay is calculated as below

Mobility of relay (i) = Avg velocity (i) + [pause time(i) * d(i)]

The relative power can be calculated as

$$Pr(i) = \frac{1}{\sqrt{2*pi}} * M(i) * BCST(i) * TX) + \frac{RX}{3*10\text{^}8} \sqrt{(Idlepower / pausetime) * TX}$$

Whereas BCST(i) is the broadcasting range of the ith relay.

Tx is the transmitted power of the ith relay

Rx is the received power of the ith relay

$$Tx = \sqrt{\sum_{r=1}^{n} b * x / Tx(n) * IE}$$

$$Rx = \sqrt{\sum_{r=2}^{n} A * y / Rx(n) * IE}$$

Whereas IE is the ideal energy of the node

Tx(n) is the transmitted power of the node

Rx (n) is the received power of the node

The relative power is the total amount of energy used by the relay in the network. The delay is equal to the sum of transmission delay and relay assigning time. Both the parameters are calculated by using formula.

B.SECOND METHOD

In the previous work, they use low- cost disposable mobile relay to reduce the total energy consumption of data-intensive WSNs. Different from mobile base stations and data mules, mobile relays do not transport data; instead, they move to different locations and then remains stationary to forward data along the path from source to the base stations. Thus, the communication delay significantly reduced compared with using mobile sinks or data mules.
Moreover, each mobile performs single relocation unlike other approaches which requires repeated relocations. But it always being active and forwards the data from source node to the base station, even when the function of mobile relay is unnecessary. It consumes more power, when the mobile relay is always being active and forwards the data.

Therefore, we use doze mobile relay nodes to reduce the total energy consumption of data-intensiveWSNs. Different

from existing technology, doze mobile relays do not always being active; instead, they goes to sleeping mode, until the noticeable variation in the data rate from the source nodes. Thus, the power consumption significantly reduced compared with using low-cost disposable mobile relay. Moreover, it consumes the energy only, when the mobile relay is in the active mode.

The doze mobile relay node does not always actively forward the data from source node to base station. It simply listen the value of the data collected from the source node. If the data rate varies, it become active and forward the data from source node to base station, otherwise it remains sleeping state.

The energy consumed by a relay for moving a distance d is modeled as

Mobility of relay = k*d

The value of the parameter k depends on the speed of the node. In general, there is an optimal speed at which k is lowest. In detail the variation of the energy consumption with respect to the speed of the mote. When the node is running at optimal speed, k = 2.

Total energy consumed by relay in the network is given as

$$E = \{TX * [M-I/2] * (R/2)+ [RX*d^2)] \}$$

Whereas

M is the mobility of the relay node.
TX is the transmitted power of the node
RX is the received power of the node.
R is the range of coverage.
D is the distance between two nodes.
I is the initial velocity at the time of transmission.

V. SIMULATION

We carried out simulations on 100 randomly generated initial topologies, each of which has 100 nodes placed uniformly at random within a 150 m by 150 m area.r1 represents the proposed system and r2 represents the existing system.

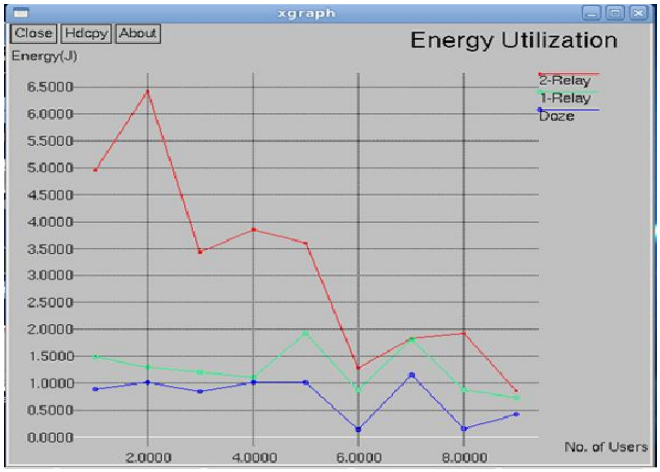

Fig.3.Comparison Graph for Energy

From the figure 3 it is shown that the energy utilized by static relay is more than the energy utilized by mobile relay. However the relaying in the existing scheme is static which may give rise to usage of large number of relay nodes, which leads to larger power consumption in the overall network. The relay in the proposed scheme is mobile whereas the user and Base station is assumed to be static. Therefore the energy consumption for each node .In order to reduce further energy consumption of the relay we considered mobile relay as doze node. From the graph it is clearly seen doze node consumes less energy.

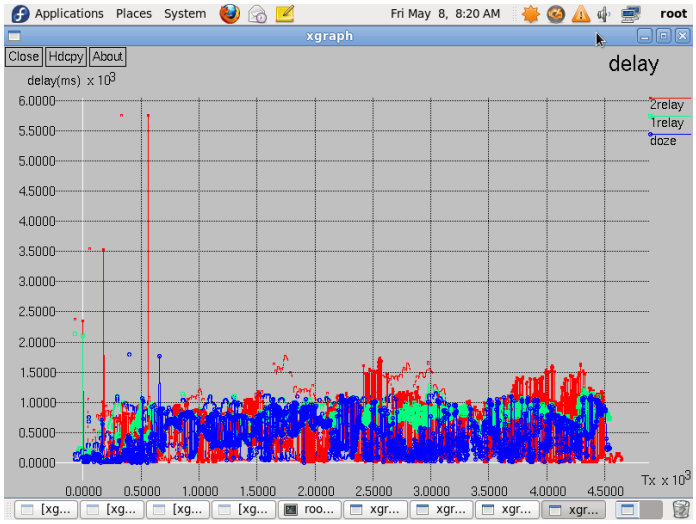

Fig.4.Comparison Graph for Energy

From the figure 4 it is shown that the delay formed by static relay is more than the delay formed by mobile relay. Since network coding and static relay in the existing method creates more delay.

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VI. CONCLUSION

Each sensor node in wireless network is equipped with limited battery supplied energy and this determines how long the node in sensor network is alive. By using proposed Relative Power Adaptable Distance Aware Routing the energy consumed by the nodes in the network is less. This is achieved by deploying the mobile relay as doze node in the network. Hence relay node will always be in sleeping state and it changes to active state only there is noticeable change in signal level and it again goes to the sleeping state after sending message. Hence energy consumed by the relay node decreases thereby the network lifetime and throughput gets increased and in the meantime the smaller delay is achieved thereby transmitting messages between sender and receiver in the shorter time.

REFERENCES

[1] Y. Xu, J.C.S. Lui, D.M. Chiu, Analysis and scheduling of practical network coding in OFDMA relay networks, Elsevier Computer Networks 53 (12) (2009) 2120–2139.

[2] H. Xu and B. Li, XOR-assisted cooperative diversity in OFDMA wireless networks: optimization framework and approximation algorithms, in: IEEE INFOCOM 2009, Rio de Janeiro, Brazil, and April 19–25, 2009.

[3] N. Wang and N. Ansari, "Identifying the Network Coding Opportunity," *Sarnoff Symposium, IEEE* 2010

[4] D. S. Lun and M. M´edard, and R. Koetter, "Network Coding for Efficient Wireless Unicast," 2006.

[5] M. J. Chaudhry, F. Saleemi, and F. J. Chaudhry, "Achieving QoS Through Network Coding," in *Proc. of the World Congress on Engineering*, 2009.

[6] C. Fragouli, J. Y. L. Boudec, and J. Widmer, "Network Coding-An Instant Primer," *ACM SIGCOMM Computer Communication Review* , 2006

[7] S. Katti, H. Rahu, W.J. Hu, D. Katabi, J. Crowcroft, XORs in the air: practical wireless network coding, in: Proceedings of ACM Sigcomm'06, Pisa, Italy, 2006.

[8] S.R. Gandham, M. Dawande, R. Prakash,and S. Venkatesan, "Energy Efficient Schemes for Wireless Sensor Networks with Multiple Mobile Base Stations," Proc. IEEE GlobeCom, 2003.

[9] J. Luo and J.-P. Hubaux, "Joint Mobility and Routing for Lifetime Elongation in Wireless Sensor Networks," Proc. IEEE INFOCOM, 2005.

[10] Z.M. Wang, S. Basagni, E. Melachrinoudis, and C. Petrioli, "Exploiting Sink Mobility for Maximizing Sensor Networks Lifetime,"Proc. 38th Ann. Hawaii Int'l Conf. System Sciences (HICSS), 2005.

[11] Kansal, D.D. Jea, D. Estrin, and .B.Srivastava,"Controllably Mobile Infrastructure for Low Energy Embedded Networks," IEEE Trans. Mobile Computing, vol. 5, no. 8, pp. 958-973, Aug. 2006.

[12] G. Xing, T. Wang, W. Jia, and M. Li,"Rendezvous Design Algorithms for Wireless Sensor Networks with a Mobile Base Station," Proc. ACM MobiHoc, pp.231-240, 2008.

[13] A.A. Somasundara, A. Ramamoorthy, and M.B. Srivastava, "Mobile Element Scheduling with Dynamic Deadlines," IEEE Trans. Mobile Computing, vol. 6, no. 4, pp.395-410, Apr. 2007.

[14]Y. Gu, D. Bozdag, and E. Ekici, "Mobile Element Based Differentiated Message Delivery in Wireless Sensor networks," Proc. Int'l Symp. World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2006.

[15] D. Jea, A.A. Somasundara, and M.B.Srivastava, "Multiple Controlled Mobile Elements (Data Mules) for Data Collection in Sensor Networks," Proc. IEEE First Int'lConf. Distributed Computing in Sensor Systems (DCOSS), 2005.

[16]R. Shah, S. Roy, S. Jain, and W. Brunette, "Data Mules: Modeling a Three-Tier Architecture for Sparse Sensor networks,"Proc. IEEE First Int'l Workshop Sensor Network Protocols and Applications(SNPA), 2003.

[17]S. Jain, R. Shah, W. Brunette, G. Borriello, and S. Roy, "Exploiting Mobility for Energy Efficient Data Collection in Wireless Sensor Networks," Mobile Networks and Applications, vol. 11, pp.327-339, 2006.

[18] C.-C. Ooi and C. Schindelhauer, "Minimal Energy Path Planning for Wireless Robots,"Proc. First Int'l Conf. Robot Comm. And Coordination (ROBOCOMM), p. 2, 2007. [19]D.K. Goldenberg, J. Lin, and A.S. Morse, "Towards Mobility as a Network Control Primitive," Proc. ACM MobiHoc, pp. 163-174, 2004.

[20] C-h. Ou, K-f. Ssu, "Routing with mobile relays in opportunistic sensor networks", *18th IEEE Int'l Symposium on Personal, Indoor and Mobile Radio Communications*, PIMRC 2007.

[21] S. Basagni, A. Carosi, E. Melachrinoudis, C. Petrioli, Z. M. Wang,"Controlled sink mobility for prolonging wireless sensor networks lifetime", *Journal on Wireless Network*, 2007.

[22] J. Luo, J. Panchard, M. Piorkowski, M. Grossglauser, J-P. Hubaux,"MobiRoute: Routing towards a Mobile Sink for Improving Lifetime in Sensor Networks", *IEEE/ACM DCOSS*, 2006.

