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PROLOGING THE NETWORK LIFETIME USING DYNAMIC MOBILE SINK FOR WIRLESS SENSOR NETWORKS

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Abstract: *Wireless Sensor Networks are used to monitor intrusion detection, battlefield surveillance, physical or environmental conditions like temperature, pressure, sound and so on because advances in micro manufacturing technology have enabled the development of low-cost, low-power, multifunctional sensor nodes for wireless communication. If the lifetime of wireless sensor network is increased means the nodes are equipped with low power battery. Energy efficient routing and sink relocating is used to increase the lifetime of sensor and this helps to increase the performance. Diverse sensing applications are also used in recent days for increasing the performance. To conserve the limited power resources of sensors to extend the network lifetime of the WSN is one of the major issues in network design. In a Wireless Sensor Network, sensor nodes deliver sensed data back to the sink through multi hopping. The sensor nodes which are present near the sink will generally consume more battery power than others and this will become one of the problems. Sink relocation is an efficient network lifetime extension method, which avoids consuming too much battery energy for a specific group of sensor nodes. Here a moving strategy called Energy-Aware Sink Relocation (EASR) is proposed for mobile sinks in WSNs. Therefore for the reduction of energy consumption of nodes, this approach uses data delivery latency. During the regular network operation, relocating the sink is very challenging. The proposed mechanism uses information related to the residual battery energy of sensor nodes to adaptively adjust the transmission range of sensor nodes and the relocating scheme for the sink. After analyzing theoretically and numerically EASR method can extend the network lifetime of the WSN.*

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1. INTRODUCTION

In the past decades, wireless sensor network (WSN), one of the fastest growing research areas, has been attracted a lot of research activities. Due to the maturity of embedded computing and wireless communication techniques, significant progress has been made. Typically, a WSN consists of a data collection unit (also known as sink or base station) and a large number of sensors that can sense and monitor the physical world, and thus it is able to provide rich interactions between a network and its surrounding physical environment in a real-time manner.

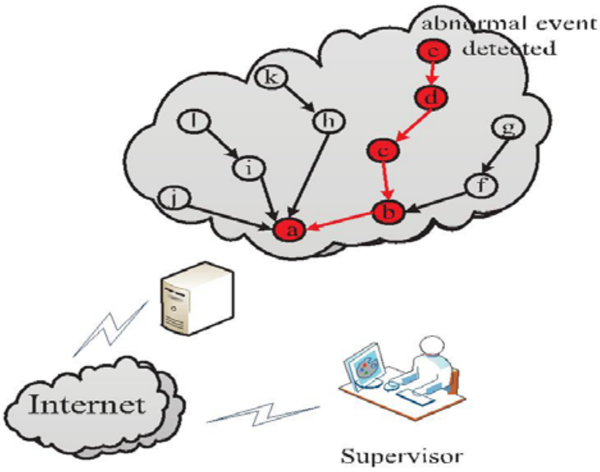


Fig. 1. An operating scheme of a WSN

The capacity-limited power sources of small sensors constrain us from fully benefitting from WSNs. Due to the unique many-to-one (converge-cast) traffic patterns, the traffic of the whole network will be converged to a specific set of sensor nodes (e.g., neighbouring nodes of the sink) and results in the hotspot problem . Much research effort has been dedicated to resolve this issue, for example, energy efficient communication protocols, multi-sink systems. However, as long as the sink and sensor nodes are static, this issue cannot be fully tackled. Therefore, there is arecent trend to exploit mobility of the sink as a promising approach to the hotspot problem.

By the way of using sink mobility, they can be classified into two categories: random mobility based and controlled mobility based. For the first category, the sink is designed to move randomly within the network. For example, Rahul et al. presented an architecture on which mobile entities (named MULEs) pick up data from sensors when in close range in sparse sensor networks. Schemes based on random mobility are straightforward and easy to implement. However, they suffer from shortcomings like uncontrolled behaviours and poor performance. Hence, recent research resorts to controlled mobility to improve the performance.

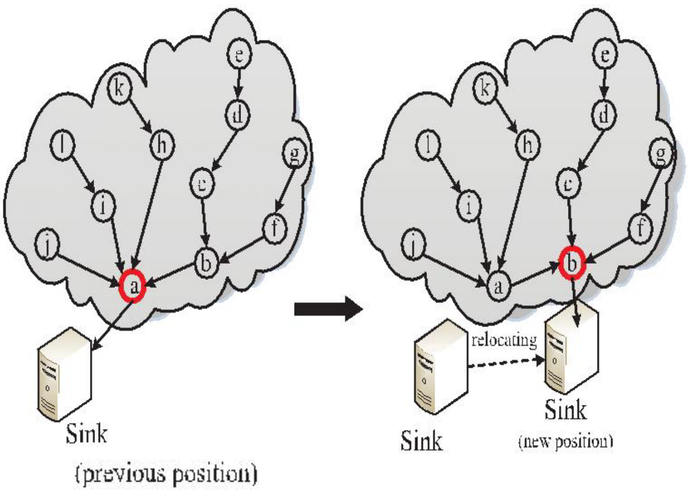


Fig. 2. Sink relocation of a WSN.

For the controlled mobility, the key problem is to deterministically schedule the sink to travel around the network to collect data. It is shown that by properly setting the trajectory even limited mobility would significantly improve the network lifetime. However, the mobility also brings new issue, i.e., the delay of the data delivery caused by the movement of the sink. Some previous proposals tried to avoid this issue by considering the so-called fast mobility, whereas the speed of the sink is sufficiently high so that the resulting delay can be tolerated. While others address this delay-bounded mobility problem by heuristics with little theoretical understanding.

2. RELATED WORK

Enhance the network lifetime, we run our network with an increasing number of sensor nodes and sinks. Then, we compared the network lifetime for each of the Mobile sinks moving in the entire network. It shows that the network lifetime increases when the number of sinks increases for all the cases. Howeverthe first sensor dies relatively quickly when the sinks are statics or moving in sensor comparing to when the sinks are moving in the whole network. In the case of static sinks, the network lifetime is clearly shorter than mobile sinks because nodes around sinks have to spend more energy to relay packets for important number of nodes which leads them to drain their energy faster. The lifetime improvement ratios obtained in 6x6 grid by deploying 3 mobile sinks in the entire network are 52 % against 3 mobile sinks moving separately in sensor and 102 % against 3 static sinks. It shows that when the network size is bigger the network lifetime is shorter for all of the cases. This is explained by the fact that there is more data traffic. Hence, sensors which are near the sinks must retransmit a higher number of packets from their higher number of neighbors which leads to faster energy depletion.inks randomly placed in a 1000x1000 square meter area. Except for testing specific capabilities of our approach, the sinks and node positions are determined randomly within the area boundaries. Each node is assumed to have an initial energy of 100 joules and is considered non-functional if its energy level reaches 0. We have carried out many experiments with various numbers of sinks and nodes to evaluate the performance of our smart movement. The experiments we present in the next sections are representative of the whole series of tests we achieved.

2.1 EXISTING SYSTEMS

Wireless sensor networks are collections of compact size and relatively inexpensive computational nodes that measure local environmental conditions or other parameters and forward such information to the base station for appropriate processing .The basic unit in a sensor network is a sensor node. Wireless sensor networks can sense the environment, communicate with neighboring nodes and can also perform basic computations on the data being collected. Recent developments in sensor technology and wireless communication have helped in the deployment of large scale wireless sensor networks for a variety of applications including environmental monitoring of habitat, data collection of temperature, pressure, sound ,humidity, light, vibration etc .For such type of applications hundreds or thousands of low cost sensor nodes can be deployed over the area to be monitored. In data gathering sensor network each sensor node must periodically report its sensed data to the sink.

1. Energy aware sink relocation method

The sink relocation method has two parts. The first part is to determine whether to trigger the sink relocation by determining whether a relocation condition is met or not.

The second part determines which direction sink is heading in and the relocation distance. For relocation condition sink periodically collect the residual battery energy of each sensor node in the wireless sensor network.

Then maximum capacity path routing protocol is used to find the maximum capacity path with respect to each sensor neighbor of the sink.For each maximum capacity path maximum capacity value is found.Sink relocation occurs when the maximum capacity value drops below a threshold value. The sink relocation mechanism takes into account the residual battery energy of the sensor node and then drive the sink to a position with a large amount of residual energy compared to others.

2. Balanced energy consumption method

The energy consumption balancing is divided into intra corona energy consumption balancing and inter corona energy consumption balancing. In intra corona energy consumption balancing each corona is divided to evenly distribute the amount of data received by nodes in each corona. In inter corona energy consumption balancing amount of data for direct transmission and hop by hop transmission is divided optimally. Balanced energy consumption is obtained by optimally distributing the amount of data for hop by hop and direct transmission at each node.All nodes in the same corona use same transmission range for direct transmission and same transmission range for hop by hop transmission.

In zone based routing each corona is divided into subcoronas and each subcorona is further divided into zones. Energy spent by transmission is proportional to the square of the transmission distance. For nodes close to the sink direct transmission is preferred. When energy consumption is balanced all nodes have same energy consumption.3.Fuzzy approach takes into account remaining energy and traffic load of node is the shortest distance from the node n to the base station .In the fuzzy approach the fuzzified values are determined by the inference engine. The inference engine has rule base. Rule base is a series of if then rules. The fuzzy implication operator used .This method of maximizing network lifetime is highly efficient.

2.2 PROPOSED WORK:

In a wireless sensor network (WSN), how to conserve the limited power resources of sensors to extend the network lifetime of the WSN as long as possible while performing the sensing and sensed data reporting tasks, is the most critical issue in the network design. This project exploits deployment of multiple mobile sinks to prolong the network lifetime in wireless sensor networks where the information delay caused by moving the sink should be bounded. In a WSN, sensor nodes deliver sensed data back to the sink via multihopping.

The sensor nodes near the sink will generally consume more battery power than others; consequently, these nodes will quickly drain out their battery energy and shorten the network lifetime of the WSN. Sink relocation is an efficient network lifetime extension method, which avoids consuming too much battery energy for a specific group of sensor nodes. In this project, we propose a moving strategy called energy-aware multiple sink relocation (EAMSR) for mobile sinks in WSNs. The proposed mechanism uses information related to the residual battery energy of sensor nodes to adaptively adjust the transmission range of sensor nodes and the relocating scheme for the sink in accordance with type and nature of traffic flow.

This technique guide the sink when and where to move to. WSNs may take the advantage of the mobile capacity, if a sink moves fast enough to deliver data with a tolerable delay. The mobile sink picks up data from nodes and transports the data. Therefore for the reduction of energy consumption of nodes, this approach trades data delivery latency. During the regular network operation, relocating the sink is very challenging. During the sink's movement, the fundamental issues are where the sink should go and how the data traffic will be handled.

1. Random movement will be given to mobile sink, when high load occur in a network this mobile sink will collect the data from the particular area, so that the load is reduced in the network.
2. Based on node density in a network another sink is placed in that particular area, so that this sink can handle the risk of communication with the neighbour nodes.

3. PERFORMANCES METRICS

We used the following metrics to evaluate the performance of our multi-sink repositioning approach and to compare it with the motionless approach:

- Time for rst node to die: This metric gives an indication of network lifetime.
- Number of delivered packets and lost packets: This metric gives a good measure of the efficiency of each approach (with and without sink movement). A good approach will lost fewer packets.
- Average delay per packet: Denned as the average time a packet takes from a sensor node to the gateway.

- Average energy consumed per packet: This metric represents the average energy consumed in transmitting and receiving a data packet. An approach that minimizes the energy consumed per packet will, in general, yields better energy savings.We have also checked that the optimal location is really inuenced by the throughput. The experiments prove that the optimal location tends to be closer to the nodes which provide the most packets. In this case we improve the throughput range of that full network and to reduce the delay of that network

3.1 Load Balancing Routing Protocol to consider energy efficiency

3.1.1. DBP

DBP(Distance Based priority) was a dynamic priority assignment mechanism for jobs under (m,k)-firm constraint[5]. The basic idea of DBP algorithm is as follows : the closer the stream to a failure state, the higher its priority is. A failure state occurs when the stream's (m,k)-firm requirement is violated. That is, the deadlines of at least m out of any consecutive k packets must be met. The term "any consecutive k packets" implies a sliding window guarantee for a flow. For each stream source, which requires an (m,k)-firm, the priority is assigned based on the number of consecutive deadline misses that leads the stream to violate its (m,k)-firm requirement. This number of deadline misses is referred to as distance to failure state from current state. The k-sequence is a word of k bits ordered from the most recent to the oldest job in which each bit keeps memory of whether the deadline is missed (bit = 0) or met (bit=1). Each new job causes a leftward shift of all the bits, the leftmost exists from the word and is no longer considered, while the rightmost will be a 1 if the job has met its deadline or a 0 otherwise The priority of its job at a given instant can be assigned with the distance of the current k-sequence to a failure state. Evolving the k-sequence can determine the violating distance of the job. That is left shift the k-sequence and adding in the right side 0s until the evolved k-sequence violates (m,k)-firm of the job, and the number of added 0s is the priority. If a job stream is already in failure state, the highest priority 0 is assigned. Normally, for a job τ with constraint β = (m,k)-firm, let priority $VD^{\beta}(\tau)$ denote its violating distance, we get

$$VD^{\beta}(\tau) = \begin{cases} k - l(m,s) + 1 & if\ \sum_{i=1}^{k} k_i(\tau) \geq m \\ 0 & if\ \sum_{i=1}^{k} k_i(\tau) < m \end{cases} \quad (1)$$

where s denote the state of the previous k sequence jobs of τ, l(m,s) denote the position (from the right) of the nth meet (or 1) in the s. However, DBP chooses the priority based on the history of the stream's k-sequence, and doesn't take into account any specific information on the actual attributes of the stream like jitter, congestion. To overcome these problem, we assign not only the priority based on $VD^{\beta}(\tau)$ but also the priority with the network state information to the flow.

3.1.2 Load Balancing Routing Protocol (LBRP)

LBRP divides the neighbor nodes into two groups. The first group, G1 contains the nodes that meet the (m,k)-firm constraint, the other, G2 contains the nodes that miss. The selection process of the forwarding candidate is as follows. In LBRP, each node keeps a flow table to store information passed by beaconing. Each entry inside the table has the following fields : (Neighbor Node ID, Speed,

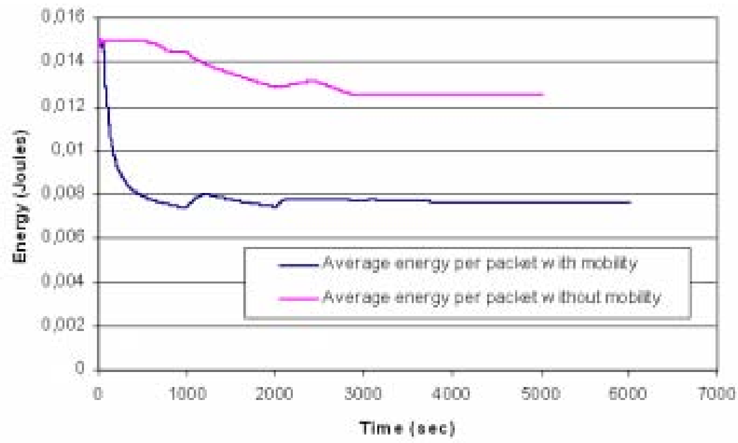
$VD^{\beta}(\tau)$, End-to-end Delay(EED), Group). Speed is calculated by dividing theadvance in distance from the next hop node j by the estimated delay to forward a packet to node j. Formally,

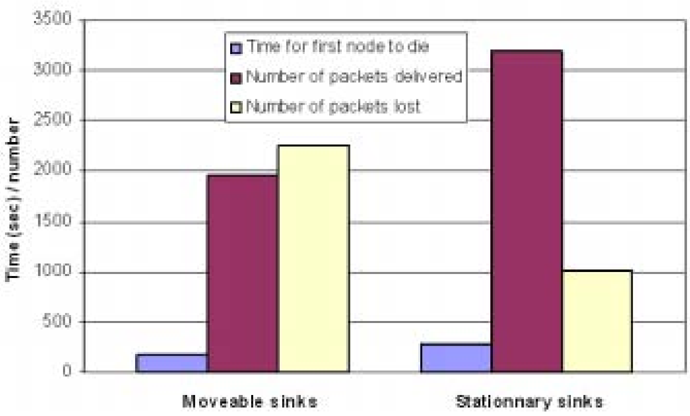
Speed = Distance from node i to next hop j / Hop Delay

First, each node investigates the speed in flow table to choose the forwarding candidate. After choosing the node with lowest speed to the neighbor node, the chosen node is checked whether it belongs to G1 or not. If it belongs to group G1, it means that the node transmits m out of its last k consecutive packets to chosen node, it is excluded the forwarding candidate. If the chosen node is in group G2, it means that it didn't receive m out of its last k consecutive packets from previous node, so it has more energy than nodes that belong to G1, Therefore, the forwarding node is chosen from the nodes that belong to G2 to balance the consumption of the energy and packets are forwarded only to it. The sink periodically sends back the value of EED to the corresponding source nodes, to inform them with the end-to-end delay of the streams they generated. So, when the node choose next node, it considers the network state information together as follows.

$$\text{NextHop} = \alpha VD^{\beta}(\tau) + (1 - \alpha)\ \text{EED}$$

After a source node receives the feedback of EED, it adds the value to the header of the packets it generates and then forwards them to the intermediate nodes.





In this case we compare the single sink vs. multiple sink relocation Finally, we can conclude that the efficiency of our approach may vary. Generally, the more the data production zones are stable, the more the efficiency is important. Moreover, in such a situation, the best performance is obtained when choosing high values for the coefficients which take into account the own in the network. On the other hand, when the zones of packet production change quickly and especially when their geographical locations are distant, the performance may be disastrous. In this case, motionless sinks approach may give better results. Therefore, a balance has to be found and the equations and their coefficients have to be adapted to the scenario. Other energy based load balancing routing protocol is

4. CONCLUSION

The depleting speeds of battery energy of sensor nodes will significantly affect the network lifetime of a WSN. Most researchers have aimed to design energy-aware routings to conserve the usage of the battery energy to prolong network lifetimes. A relocatable sink is another approach for prolonging network lifetime by avoiding staying at a certain location for too long which may harm the lifetime of nearby sensor nodes. This approach can not only relieve the burden of the hot-spot, but can also integrate the energy-aware routing to enhance the performance of the prolonging network lifetime. In this project, it have been proposed an energy-aware sink relocation method (EASR), which adopts the energy-aware routing MCP as the underlying routing method for message relaying. Theoretical analysis is done to demonstrate that EASR can prolong the network lifetime of a WSN. In addition, the simulation results show that the EASR method outperformed the other compared methods in the network lifetime comparisons under 4 different simulation scenarios.

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