Hierarchical Packet Forward Using Cluster Routing Protocol in Wireless Sensor Network

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Abstract-Wireless Sensor Networks (WSNs) are used in many applications in military, ecological, and health-related areas. Recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Most of the attention, however, has been given to the routing protocols since they might differ depending on the application and network architecture. Increased interest in the potential use of wireless sensor networks (WSNs) in a wide range of applications and it has become a hot research area is clustering method requires the lifetimes of all sensor nodes in the CH selection procedure, and massive resources will be consumed by exchanging the status information in a distributed WSN. Every node becomes a CH candidate with a preset threshold T, which can be adjusted to control the proportion of candidates. Because only CH candidates participate in CH selection, other nodes staying awake in the working mode will inevitably consume energy and thus reduce the network lifetime. To guarantee network connectivity and reduce the energy consumption, a sleep scheduling algorithm is applied to some sensors, where nodes except CH candidates enter the sleeping mode.

Key words: network lifetime, energy consumption, sleep scheduling algorithm, cluster head, wireless sensor network

I. INTRODUCTION

Wireless sensor networks (WSNs) use small nodes with constrained capabilities to sense, collect, and disseminate information in many types of applications. As sensor networks become wide spread, security issues become a central concern, especially in mission critical tasks.WSNs are used in many applications in military, ecological, and health related areas. These applications often include the monitoring of sensitive information such as enemy movement on the battlefield or the location of personnel in a building. Security is therefore important in WSNs. However, WSNs suffer from many constraints, including low computation capability, small memory, limited energy resources, susceptibility to physical capture, and the use of insecure wireless communication channels. These constraints make security in WSNs a challenge. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. Routing protocols in WSNs might differ depending on the application and network architecture.

Deployment of a sensor network in these applications can be in random fashion (e.g., dropped from an airplane in a disaster management application) or manual (e.g., fire alarm sensors in a facility or sensors planted underground for precision agriculture).Creating a network of these sensors can assist rescue operations by locating survivors, identifying risky areas, and making the rescue team more aware of the overall situation in a disaster area. Typically, WSNs contain hundreds or thousands of these sensor nodes, and these sensors have the ability to communicate either among each other or directly to an external base station (BS).

The intensive research that addresses the potential of collaboration among sensors in data gathering and processing, and coordination and management of the sensing activity was conducted. In most applications, sensor nodes are constrained in energy supply and communication bandwidth. Thus, innovative techniques to eliminate energy inefficiencies that shorten the lifetime of the network and efficient use of the limited bandwidth are highly required. Such constraints combined with a typical deployment of large number of sensor nodes pose many challenges to the design and management of WSNs and necessitate energy-awareness at all layers of the networking protocol stack.

For example, at the network layer, it is highly desirable to find methods for energy-efficient route discovery and relaying of data from the sensor nodes to the BS so that the lifetime of the network is maximized. Routing in WSNs is very challenging due to the inherent characteristics that distinguish these networks from other wireless networks like mobile ad hoc networks or cellular networks. First, due to the relatively large number of sensor nodes, it is not possible to build a global addressing scheme for the deployment of a large number of sensor nodes as the overhead of ID maintenance is high. Thus, traditional IP-based protocols may not be applied to WSNs.

The system proposed a centralized algorithm for the problem by solving an integer linear program [2]. And it also developed fair rate allocation algorithms by incorporating temporal-spatial sensing data correlations. They proposed an efficient algorithm for finding the accumulative sum of utility gains in a tree network [17]. And they formulated the sub sink choice problem as a problem of minimizing the number of hops from each sensor to its sub sink by providing a heuristic solution. Due to such differences, many new algorithms have been proposed for the problem of routing data in sensor networks. These routing mechanisms have considered the characteristics of sensor nodes along with the application and architecture requirements. Almost all of the routing protocols can be classified as data-centric, hierarchical or location based although there are few distinct ones based on network flow or quality of service (QoS) awareness.

Data-centric protocols are query-based and depend on the naming of desired data, which helps in eliminating many redundant transmissions. Hierarchical protocols aim at clustering the nodes so that cluster heads can do some aggregation and reduction of data in order to save energy [13]. Location-based protocols utilize the position information to relay the data to the desired regions rather than the whole network. The last category includes routing approaches that are based on general network-flow modeling and protocols that strive for meeting some QoS requirements along with the routing function.

However, sensor nodes are constrained in energy supply and bandwidth. Such constraints combined with a typical deployment of large number of sensor nodes have posed many challenges to the design and management of sensor networks. These challenges necessitate energy-awareness at all layers of networking protocol stack. The issues related to physical and link layers are generally common for all kind of sensor applications, therefore the research on these areas has been focused on system-level power awareness such as dynamic voltage scaling, radio communication hardware, low duty cycle issues, system partitioning, energy-aware MAC protocols.

II. RELATED WORK

The system formulates a novel data collection maximization problem by incorporating multi-rate transmissions and transmission time slot scheduling, and show the NP-hardness of the problem [2]. And it uses Sleep scheduling algorithm to conserve energy. The system also extends the proposed algorithm by minor modifications to solve a generalized case of the problem where the harvested energy at each sensor is not given and link communications are unreliable [2]. An exact solution proposed for a special case of the problem where each sensor has a fixed transmission power, and finally conducts extensive experiments by simulations to evaluate the performance of the proposed algorithms. Most sensor nodes should be in sleep mode most of the time so that the energy consumption by each node is reduced [15].

As sensors are powered by renewable energy, the amount of energy harvested by a sensor at each different time slot is different. This implies that a sensor cannot transmit its data to the mobile sink without any restriction. The communication reliability of a receiver usually is determined by its received Signal-to-Noise Ratio (SNR). The communication reliability of the mobile sink can be maximized if a sensor uses its maximum transmission power level to transmit its data to the sink [5][8]. This however incurs unnecessarily high energy consumption of the sensor.

Intuitively, each sensor should transmit its data to the mobile sink at all available time slots to it in order to maximize its share on the collected data, thereby maximizing the volume of the data collected from the entire network. However, since the energy replenishment rate of each sensor is much slower than its energy consumption rate, each sensor may only make use of some of all available time slots to transmit its data due to its energy budget. Therefore, both harvested energy predictions and unreliable link reliability must be taken into account when dealing with the design of real protocols for energy renewable sensor networks.

III PROPOSED ALGORITHM

A. *Network Layer*

Routing protocols are implemented primarily in the network layer and they are in charge of discovering and maintaining the routes in the network. Most of the routing protocols designed for WSNs consider energy efficiency as the main objective, with the assumption that data does not have stringent QoS requirements[13][16]. They can be classified as data centric, hierarchical, location based or network-flow protocols.

In data centric protocols, queries are posed for specific data and routing is performed using the knowledge that is aggregate or metadata. Hierarchical protocols minimize energy consumption by dividing nodes into clusters. Location-based protocols take advantage of the location information to make routing techniques more efficient. In network-flow protocols, route step is modeled and solved as a network-flow problem.

QoS metrics that can be fulfilled at the network layer are the following

- Minimizing path latency/delay.
- Maximizing routing reliability.
- Minimizing energy consumption.
- Minimizing congestion probability.
- Providing effective sample rate.

Routing techniques are used to improve the energy efficient. Some of the routing QoS techniques are,

- Multipath routing
- Minimum cost forwarding
- Energy aware routing

B. Overview of work

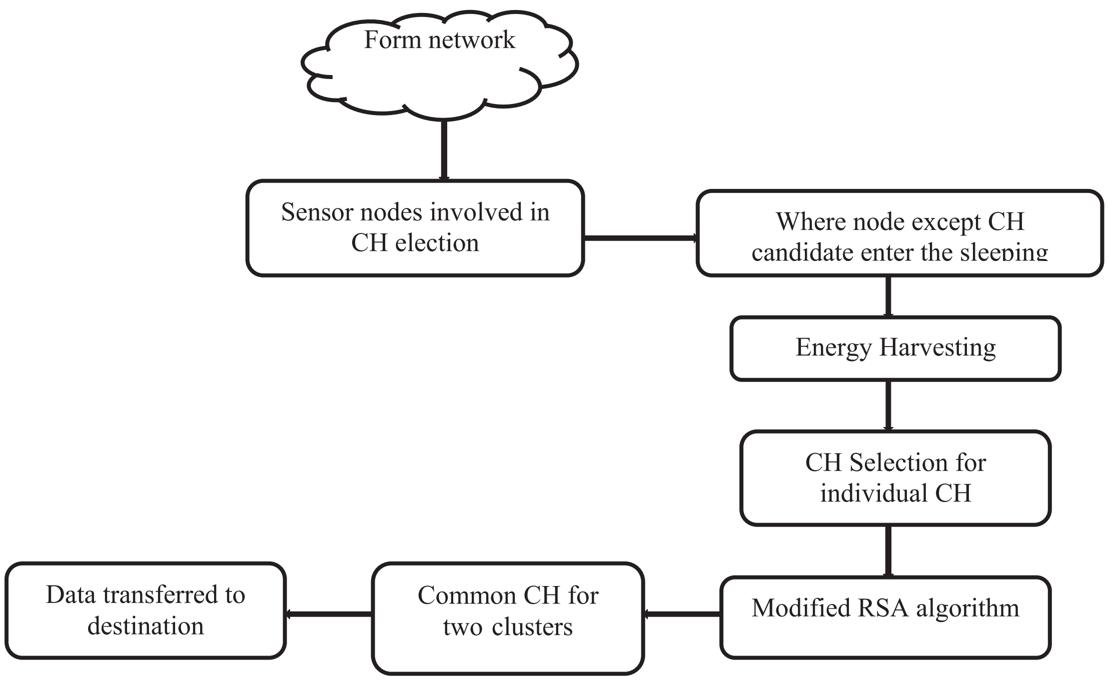


Figure 1. System Architecture

C. Network Formation

Clustering methods and energy harvesting techniques come as a natural combination for prolonging the network lifetime. A proper formation of clusters liberates most sensors from high energy consumptions, while a carefully planned sparse deployment of EH sensors helps prolong the lifespan of the bottleneck nodes. Since energy harvesting rates are sensitive to the environment, it may not be practical to let EH nodes serve as function critical nodes such as CHs. EH sensors serve as relay nodes for CHs[14]. By communicating with EH nodes over a shorter distance rather than sending data to BS directly, CHs can have lowered energy consumptions for at least a certain fraction of time.

The Distributed Coordination Function (DCF) of the IEEE 802.11 protocol is used as the MAC layer protocol. The radio channel model follows a Lucent's WaveLAN with a bit rate of 2 Mbps, and the transmission range is 250 meters.To consider constant bit rate (CBR) data traffic and randomly choose different source-destination connections. Every source sends four CBR packets whose size is 512 bytes per second. The mobility model is based on the random waypoint model in a field of 1;000 m X 1;000 m.

D. Time Sharing Process

WSN, parameters may be redefined dynamically along the time in accordance with the patients´ clinical state. For example, a higher monitoring activity of the patients´ vital signals might be required when the clinical situation changes from non-critical to critical, implying the redefinition of the sampling rate parameter [8]. The setting of an e-health parameter value may be decided and announced to the WSN by the BS. Changing the value of a single parameter value may require a complete time-slot rescheduling of the WSN. If the TDMA-based MAC protocol uses short size beacons, the BS cannot assign the time-slots in the beacon explicitly. In this case, each mote must run an algorithm in the MAC layer to find the time-slots to transmit a frame. As WSNs are collaborative networks working towards a common goal, the time-slot scheduling algorithm running in a mote must operate collaboratively.

A real-time scheduling strategy(RTS) that is included message scheduling and scheduling strategy for sensor network OS[5], for this reason the researchers analyzed system architecture of TinyOS, FIFO scheduling TinyOS, task mechanism and event-driven mechanism. TinyOS is an event-driven operating system designed for sensor-network nodes that have limited memory and computational resources. TinyOS enables developers to access low-level hardware resources at the application level, thus resulting in a level of data-acquisition and communications flexibility that is unavailable to other existing mainstream wireless communications technologies.

E.Digital Distribution Process

The solution obtained is based the assumptions that the global knowledge of the network topology and the profiles of sensors including their physical locations, energy budgets, starting and ending time slots are available. In reality, there is no way for the mobile sink to know the profile of each sensor unless it is within the transmission range of the sensor. Also, even if the mobile sink is able to collect the topological information of the entire network and the profiles of sensors at its previous tours, using the piggybacking strategy or linear regression prediction, it then performs time slot scheduling based on the collected information, the solution obtained however may not be applicable due to the fact that both the energy harvesting and the link reliability profiles of some sensors may have experienced drastic changes over the period of the mobile sink tour. To develop a fast, scalable online distributed algorithm for the problem without the mentioned assumptions. For the sake of discussion convenience, first assume that all links are reliable, i.e., the link reliability of each link is one. Then extend the distributed solution to the unreliable link case through minor modifications.

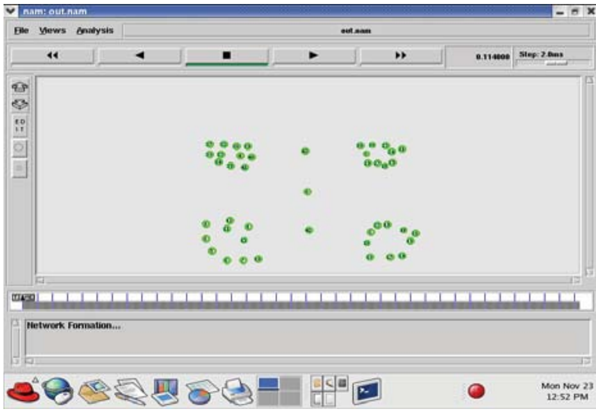
F. Cryptography Security Process

The system chooses RSA algorithm.RSA algorithm is base for the modified algorithm, in RSA algorithm or (*) operation is implemented. In cryptography security process are going to implement ex-or operation. In WSNs, four major security requirements are integrity, confidentiality, and authentication. Encryption is used to ensure confidentiality and message authentication code (MAC), functioning as a secure checksum, provides the data integrity and authentication in the network. A sleep scheduling algorithm is applied to some sensors, where nodes except CH candidates enter the sleeping mode. After the CH selection process is completed, CHs send wakeup messages to those sleeping nodes for cluster formation. Finally, the introduced sleep scheduling algorithm involving the node mobility consideration can flexibly suit the dynamic topology changes, which provides favorable scalability. Sleep scheduling algorithms most of the nodes are put to sleep to conserve energy and increase network life time [4].

- Most sensor nodes should be in sleep mode most of the time so that the energy consumption by each node is reduced.
- Consumption of energy by all the sensor nodes remains balanced, i.e., at any time, every node should have consumed nearly the same amount of energy.
- Load shared by each node must be same so that no node is over used.
- Time required to transmit data from a sensor node to the sink is as minimum as possible

Whenever a node detects an event it transit in active mode and transmit their data to destination and after transmission they again transit into sleep mode. The cipher text is the same as the plaintext in some values of n which is the product of two prime numbers p and q.So it is very important to find an effective solution for such a problem because it is vulnerable for most common attacks

IV. PERFORMANCE EVALUATION



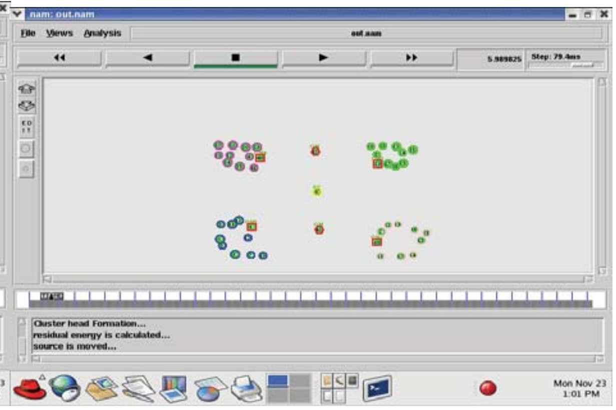
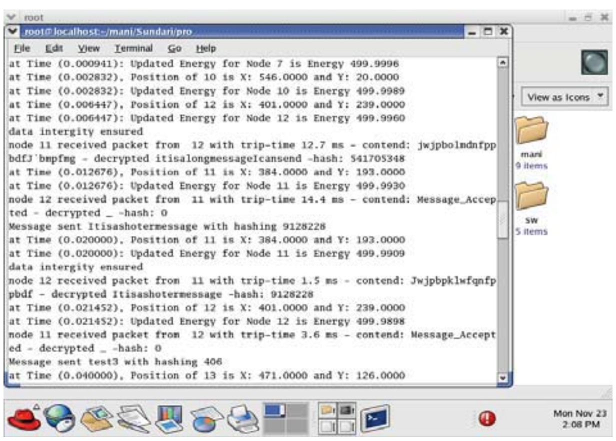


Figure2.Cluster Formation

Figure 3.Finding the Neighbor Node

Figure 2 shows the multiple nodes are combined as one cluster group. It formed the four groups of clusters. Figure 3 To finding neighbors while sending and receiving RREQ and RREP.It determines the efficiencies of energy transferring and the latency of data gathering process.



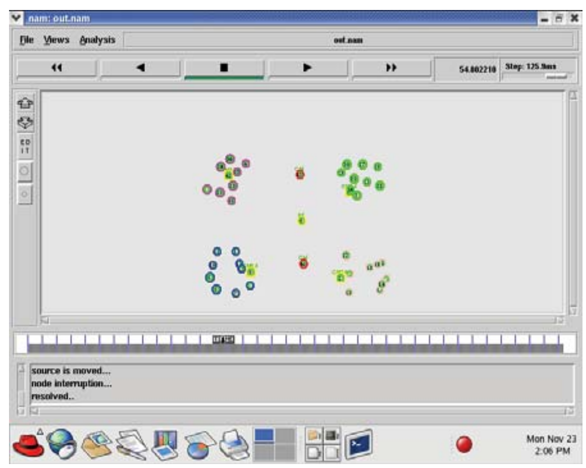


Figure 4.Consumption of Energy.

Figure 5.Secure Data Transmission

Figure 5 shows the data transmission of RREQ and RREP are secured using symmetric key cryptography

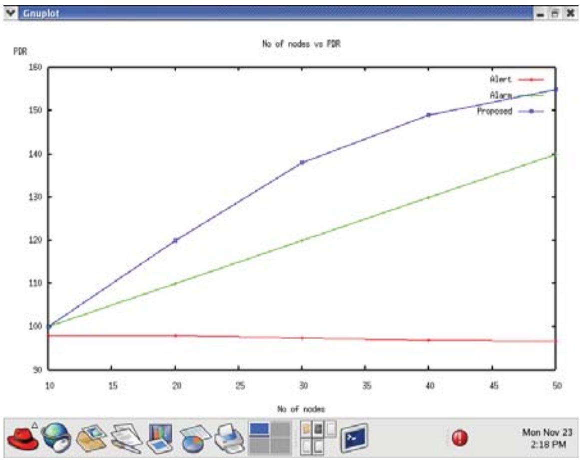


Figure 7.Power Analysis

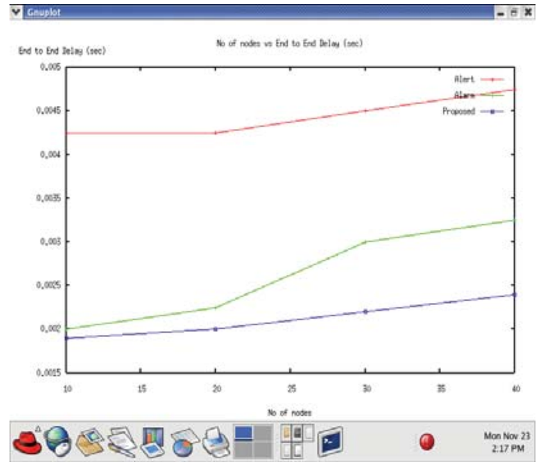


Figure 8. End to End Delay

Figure 7 shows the energy consumption of no of nodes in the system. And figure 8 shows the no of nodes vs. end to end delay. The delay time is estimated as 0.002 s with respect to nodes.

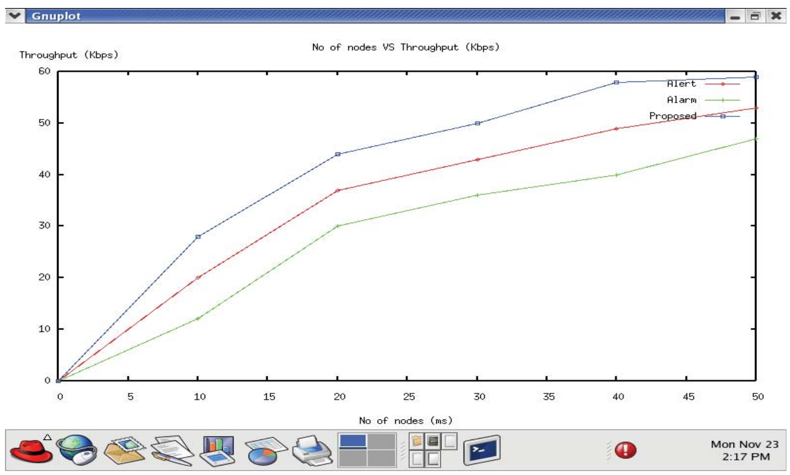


Figure 9.No of Nodes vs. Throughput

The above graph explains the throughput rate of the system. The throughput rate is estimated as 50 kbps with respect to number of nodes.

V. CONCLUSION

The system has proposed Sleep scheduling algorithm to conserve energy. And it formulated a novel data collection maximization problem. And it developed a fast, scalable online distributed algorithm for the problem without the global knowledge of the network and sensor profiles. Finally the result shows that it is very scalable and more efficient. For future work, plan to thoroughly study the EH rate prediction technology for a more precise node capability estimation. Due to the development of mobile sensor nodes in practice, further research is planned on scalability, applicability, and efficiency of data forwarding and sleep scheduling algorithms, by which EH technology can be introduced to WSNs with mobile sensors, further optimizing energy efficiency and network lifetime.

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