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Survey on Routing Protocol in Wireless Sensor Network

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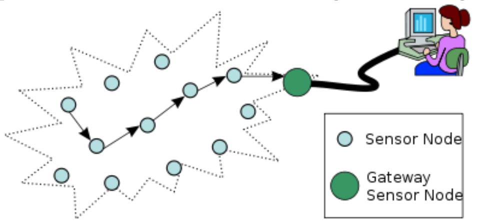
***Abstract**— The Wireless sensor network has number of applications but data gathering is the major application in which Wireless Sensor Network is used to periodically collect data from sensor field. Various numbers of protocols are used in order to maximize life time by efficient use of energy. Direct transmission, binary scheme, LEACH, PEGASIS are discussed in this paper .LEACH communicate by using cluster heads and PEGASIS involve leader selection.*

***Keywords**— Wireless Sensor Network, LEACH, PEGASIS, GA, Data gathering.*

I. INTRODUCTION

A wireless sensor network (WSN) of spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.



The main characteristics of a WSN include:

- Power consumption constraints for nodes using batteries or energy harvesting
- Ability to cope with node failures .
- Mobility of nodes.
- Heterogeneity of nodes .
- Scalability to large scale of deployment .
- Ability to withstand harsh environmental conditions .
- Ease of use .

II. ROUTING PROTOCOLS IN WSN

Routing in wireless sensor networks differs from conventional routing in fixed networks in various ways. There is no infrastructure, wireless links are unreliable, sensor nodes may fail, and routing protocols have to meet strict energy saving requirements [5]. Many routing algorithms were developed for wireless networks in general. All major routing protocols proposed for WSNs may be divided into seven categories as shown in Table 1. We review sample routing protocols in each of the categories in preceding sub-sections.

Table 1: Routing Protocols for WSNs

Category	**Protocols**
Location-based Protocols	MECN, SMECN, GAF.
Data-centric Protocols	SPIN, COUGAR, EAD .
Hierarchical Protocols	LEACH, PEGASIS, HEED
Mobility-based Protocols	SEAD, TTDD,
Multipath-based Protocol	Braided Multipath
Heterogeneity-based	IDSQ, CADR
QoS-based protocols	SAR, SPEED

III. LEACH PROTOCOL

Low Energy Adaptive Clustering Hierarchy ("LEACH") is a TDMA-based MAC protocol which is integrated with clustering and a simple routing protocol in wireless sensor networks (WSNs). The goal of LEACH is to lower the energy consumption required to create and maintain clusters in order to improve the life time of a wireless sensor network. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

Nodes that have been cluster heads cannot become cluster heads again for P rounds, where P is the desired percentage of cluster heads. Thereafter, each node has a $1/P$ probability of becoming a cluster head in each round. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot. LEACH also uses CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters.

A. Advantages

- Outperforms conventional routing protocols
- LEACH is completely distributed, requiring no control information from the base station
- Nodes do not need global topology information

B. Disadvantages

- Nodes must have data to send in the allotted time
- Perfect correlation is assumed, which might not be true always

IV. PEGASIS PROTOCOL

Power-Efficient Gathering in Sensor Information Systems (PEGASIS): PEGASIS is aextension ofthe LEACH protocol, which forms chains from sensor nodes so that each node of transmits and receives from a neighbor and only one node is selected from that chain to transmit to the base station (sink). The data is gathered and moves from node to node, aggregated and eventually sent to the base station. The chain construction is performed in a greedy way. Unlike LEACH, PEGASIS avoids cluster formation and uses only one node in a chain to transmit to the BS (sink) instead of using multiple nodes. A sensor transmits to its local neighbors in the data fusion phase instead of sending directly to its CH as in the case of LEACH. In PEGASIS routing protocol, the construction phase assumes that all the sensors have global knowledge about the network, particularly, the positions of the sensors, and use a greedy approach. When a sensor fails or dies due to low battery power, the chain is constructed using the same greedy approach by bypassing the failed sensor. In each round, a randomly chosen sensor node from the chain will transmit the aggregated data to the BS, thus reducing the per round energy expenditure compared to LEACH. Simulation results showed that PEGASIS is able to increase the lifetime of the network twice as much the lifetime of the network under the LEACH protocol. Such performance gain is achieved through the elimination of the overhead caused by dynamic cluster formation in LEACH and through decreasing the number of transmissions and reception by using data aggregation. Although the clustering overhead is avoided, PEGASIS still requires dynamic topology adjustment since a sensor node needs to know about energy status of neighbors in order to know where to route its data. Such topology adjustment can introduce significant overhead especially for highly utilized networks.

V. GENETIC ALGORITHM

The genetic algorithm is a probabilistic search algorithm that iteratively transforms a set (called a *population*) of mathematical objects (typically fixed-length binary character strings), each with an associated fitness value, into a new population of offspring objects using the Darwinian principle of natural selection and using operations that are patterned after naturally occurring genetic operations, such as crossover (sexual recombination) and mutation.

VI. RELATED WORK

W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-Efficient Communication Algorithm for Wireless Microsensor Networks," Proceeding of the 33rd International Conference on System Sciences, pp. 1-10, 2000. Wireless distributed microsensor systems will enable the reliable monitoring of a variety of environments for both civil and military applications. In this paper, we look at communication protocols, which can have significant im-pact on the overall energy dissipation of these networks. Based on our findings that the conventional protocols of direct transmission, minimum-transmission-energy, multi-hop routing, and static clustering may not be optimal forsensor networks, we propose LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol thatutilizes randomized rotation of local cluster base stations(cluster-heads) to evenly distribute the energy load among the sensors in the network .LEACH uses localized coordination to enable scalability and robustness for dynamic net-works, and incorporates data fusion into the routing proto-col to reduce the amount of information that must be trans-mitted to the base station.

M. J. Handy, M. Haase, and D. Timmermann, "Low Energy Adaptive Clustering Hierarchy with Deterministic Cluster-Head Selection," 4th International Workshop on Mobile and Wireless Communications Network, pp. 368-372, 2002.This paper focuses on reducing the power consumption of wireless micro sensor networks. Therefore, a communication protocol named LEACH (Low-Energy Adaptive Clustering Hierarchy) is modified. We extend LEACH's stochastic cluster-head selection algorithm by a deterministic component.

B. Krishnamachari, D. Estrin, and S. Wicker, "The Impact of Data Aggregation in Wireless Sensor Networks," 22nd International Conference on Distributed Computing Systems Workshops, pp. 575-578, 2002. Sensor networks are distributed event-based systems that differ from traditional communication networks in several ways: sensor networks have severe energy constraints, redundant low-rate data, and many-to-one flows. Data-centric mechanisms that perform in-network aggregation of data are needed in this setting for energy-efficient information flow. In this paper we model data-centric routing and compare its performance with traditional end-to-end routing schemes. We examine the impact of source-destination placement and communication network density on the energy costs and delay associated with data aggregation.

J. N. Al-Karaki, and A. E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey," IEEE Wireless Communications, vol. 11, no. 6, pp. 6-28, 2004. Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. The focus, however, has been given to the routing protocols which might differ depending on the application and network architecture. In this paper, we present a survey of the state-of-the-art routing techniques in WSNs. We first outline the design challenges for routing protocols in WSNs followed by a comprehensive survey of different routing techniques. Overall, the routing techniques are classified into three categories based on the underlying network structure: flat, hierarchical, and location-based routing. Furthermore, these protocols can be classified into multipath-based, query-based, negotiation-based, QoS-based, and coherent-based depending on the protocol operation. We study the design tradeoffs between energy and communication overhead savings in every routing paradigm.

Ossama Younis, Student Member, IEEE, and Sonia Fahmy, Member, IEEE "Transactions on Mobile Computing'' october-december 2004 . Topology control in a sensor network balances load on sensor nodes and increases network scalability and lifetime. Clustering sensor nodes is an effective topology control approach. In this paper, we propose a novel distributed clustering approach for long-lived ad hoc sensor networks. Our proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. We present a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in Oð1Þ iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network. We prove that, with appropriate bounds on node density and intracluster and intercluster transmission ranges, HEED can asymptotically almost surely guarantee connectivity of clustered networks. Simulation results demonstrate that our proposed approach is effective in prolonging the network lifetime and supporting scalable data aggregation.

VII. CONCLUSION

Data gathering is the process of collecting information from sensor nodes at the Base Station. This paper describes various data gathering methods. LEACH uses clusters and more efficiently consume energy as compared to direct method. PEGASIS is most efficient as compared to both Direct and LEACH. In PEGASIS chain construction is done by using Greedy algorithm. By using GA it also gives better performance as compared to previous one.

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