

## The routing of wireless sensor path query optimization research

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**Abstract**—the wireless sensor network and its characteristics of the study concluded, that the wireless sensor network (WSN) and sensor network and ad hoc network. And the key problems need to be solved. On several of today's popular WSN hierarchical routing protocols are analyzed and summarized. On whether the data centric, whether to support the data fusion, based on whether the node localization, quality of service (QoS), scalability, robustness and safety and other aspects of the comparison, and points out its advantages and disadvantages. Finally it is pointed out that the current WSN routing protocol is committed to meet basic performance on the improvement of QoS.

**Keywords**-wireless sensor network; routing protocol; hierarchical; performance comparison

### I. INTRODUCTION

Sensor data acquisition, information processing is the key component in the physical world, it can be a physical quantity is mapped to a value of quantitative measurement, so that people on the physical world quantified understanding. Sensor technology is the new technology revolution and the information society technology based on [1]. Along with the development of microelectronics, computer and the development of network technology, sensor technology towards miniaturization, intelligent, networked, integrated direction [2]. Wireless sensor network ( WSN ) consists of sensing, data processing and short distance wireless communication function of the sensor, in military, environmental monitoring, medical, disaster relief and commercial applications and other fields have broad application prospects [3]. Only the networked smart sensor technology can adapt to all kinds of control system on automatic level, complexity and adaptability to the environment ( such as high temperature, high speed, high altitude field, underground, etc.) the increasingly high requirements of the [1]. In recent years, along with the sensor is applied more and more widely, for the wireless sensor network routing technology to request more and more high. Now a lot of workers are dedicated to the study of WSN routing protocol, and have made great progress.

This paper mainly on those routing protocols are summarized and compared.

### II. THE CHARACTERISTICS OF THE WIRELESS SENSOR NETWORK

WSN is a distributed, self-organizing sensor networks, with wide coverage, adaptive strong, layout, convenient and flexible characteristics. Compared with the traditional fixed network are very different, mainly has the following two features of [4]:

(1) with data as the center. Environmental perception data processing and transmission in the wireless sensor network wireless sensor network core, all functions are around data receiving, processing, transmission and application of. Users in the use of wireless sensor network is the will to want things to know tell sensor network, sensor network in access to the specified target event information gathering and reporting to the user, the user does not need to know what is the data from which the sensor node.

(2) highly oriented application system. Sensor task is the perception of the objective environment, different application background of the different environments, are concerned with physical quantities and different, so the sensor network requirements also vary.

### III. ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS NEEDS TO SOLVE THE PROBLEM

(1) As the wireless sensor network and traditional network is different, in the design of WSN routing protocol should be based on its characteristic design appropriate routing protocol. A good WSN network layer routing protocol design should meet the following conditions [1]:

(2) simple and energy saving. In order to efficiently use the limited cyber source, the possible compression unnecessary expenses, to maximize the survival time of the network, routing protocol design must have a simple and energy saving.

### IV. HIERARCHICAL ROUTING PROTOCOLS OF WIRELESS SENSOR NETWORKS

At present, there are many routing protocol routing protocol, these mostly has the following characteristics:

(1) sensor nodes according to the attributes of data addressing, rather than the IP addressing.

(2) sensor node detects the data is sent to the Sink node.

A. *The LEACH protocol*<sup>[11]</sup>

LEACH is the basic idea of the whole network into different clusters, the cluster node data sent and received by the cluster head is responsible for, the cluster head nodes in a circular pattern of random selection, so the network load is evenly distributed across the network, greatly saves the communication in the process of energy loss. The simulation results show that the [1]126 page with general plane multi-hop routing protocol and Static Slicing Algorithm of LEACH network can be compared, the extension of the life cycle of 15%. LEACH defines a "wheel" or "round (round)" concept, LEACH running process is continuous cycle process. Each turn consists of two phases: cluster establishment phase and the stable phase of data transmission. On the cluster head selection algorithm, LEACH uses distributed. Select the cluster head specific approach is: in each round, round first stage, sensor nodes are randomly selected from 0 to 1 between a numerical, if this value is less than a certain threshold value T(n), then the node is selected for the cluster head node. Node n threshold value T(n) is calculated by the following formula:

$$T(n) = \begin{cases} \frac{k}{N - k \left[ \text{rmod} \left( \frac{N}{k} \right) \right]} & n \in G \\ 0 & n \notin G \end{cases} \quad (1)$$

(1) Type : N network sensor node number; K for a cluster head in the network nodes; R as has been done with the round number; G in the remaining r wheel is not a cluster head node of sensor node set.

(2) The selected cluster head node, the entire network via radio to inform. Other nodes in the network according to the combined information signal strength determines the slave cluster, and notify the corresponding cluster head node, the establishment of complete cluster. The final cluster head node uses the TDMA method to cluster in each node is assigned to the data transmission time slice.

(3) The characteristics of LEACH protocol [1]:

(4) in order to reduce the amount of information transmitted to the point of convergence, the cluster head node is responsible for the fusion from cluster within the

source node of the resulting data, and the fusion data is sent to the sink node.

(5) LEACH TDMA/CDMA based on the MAC layer mechanism to reduce the conflict between the clusters and cluster.

B. *TEEN protocol*<sup>[12]</sup>

The advantages of TEEN protocol are summarized below:

(1) protocol suited to the need for real-time sensing applications.

(2) by setting the hard threshold and the soft threshold two parameters, TEEN can greatly reduce the number of data transmission, more energy-efficient than LEACH algorithm.

(3) due to the soft threshold can be altered, the monitor by setting different soft threshold can easily balance monitoring accuracy and energy saving of system two index.

The existing problems of TEEN is: on the one hand, if the node monitoring data has not been able to exceed the set hard threshold, the node will transmit the data, the user will not be able to get any data, also do not know whether the node failure; on the other hand, the node monitor to the appropriate data will be transmitted in real time data, using TDMA mechanism will cause the data delay.

C. *APTEEN protocol*

APTEEN ( adaptive periodic threshold sensitive energy efficient sensor network protocol ) is LEACH and TEEN combination, both active and in response to two types of data transmission mode, is a mixed type data transmission mode WSN.APTEEN based on neighboring nodes to monitor the same object hypothesis, by the base station using the simulated annealing algorithm to cluster nodes into sleeping-idle node to node is responsible for responding to the query, idle, sleeping nodes into sleep mode to save energy, the two node in the cluster head rotation conversion role.APTEEN to modify LEACH TDMA(as shown in figure 1[14]), each sleeping-idle node belong to slot between TDMA frame length by half, if an emergency data, sleeping-idle node pair can occupy other slot, improve data response speed.

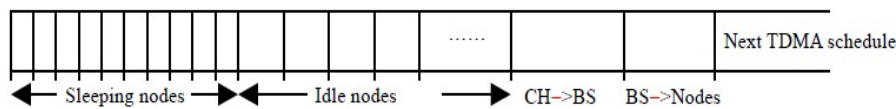


Figure 1 Curve chart on reduction of network training errors

D. *PEGASIS protocol*

The PEGASIS data in the shortest distance between adjacent nodes and node transmission, with only the minimum power transmission of data packets, at each intermediate node also carried out data fusion, thus reducing the traffic network, the power consumption is reduced. In fact, reference [13] research findings also show that, using

the PEGASIS sensor network lifetime is the use of LEACH network of nearly 2 times.

The PEGASIS protocol is [1]:

(1) protocol assumes that each sensor node is capable of directly with the convergence point of communication, and in fact, sensor nodes are usually use multi-hop way to reach the sink node.

(2) PEGASIS assumes that all sensor nodes have the same level of energy, so the node is possible at the same time all died within.

(3) despite the agreement to avoid constructing cluster overhead, but because the sensor nodes need to know its neighbor nodes' energy state information to transmit data, the agreement still needs to be dynamically adjust the topology structure. For those with higher utilization rate of the network, the topology of the adjustment will bring greater energy expenditure.

(4) protocol to construct node link, remote node will cause excessive delay of data, and the first chain node uniqueness makes the first chain will become a bottleneck.

E. HEED<sup>[14]</sup>

HEED ( hybrid energy-efficient distributed clustering ) points out: extended life cycle, scalability and load balance in WSN is 3 of the most important requirements, and the energy consumption of the average distribution of the whole network to extend the network life cycle.

F. ACE protocol<sup>[14]</sup>

ACE ( algorithm for cluster establishment ) is a kind of good feedback mechanism for distributed adaptive clustering algorithm. Cluster formation comprising a cluster and cluster migration two logical parts. Based on the information feedback between adjacent nodes, each node independently run ACE algorithm, by the end of two logical parts of cross iteration form clusters.

In the operation process of ACE algorithm, the node is divided into 3 states: unclustered, clustered and cluster-head. unclustered node without adding any cluster node, clustered has become the one or more cluster member, cluster-head node has a cluster head. Each iteration cycle coming, according to different node state run different iterative algorithm.

If A is unclustered node, it calculated if it becomes a cluster head node, neighbor node in loyalty (loyalty node refers to those who only belongs to one cluster node) of the number of L, if  $L \geq F_{min}(T)$ , then A a cluster head, and

then select a random number as a cluster ID, radio RECRUIT message, received the message nodes to join the A cluster.  $F_{min}(T)$  is a cluster restriction function, with the protocol running time of T increased,  $F_{min}$  decreased . This is conducive to the starting form topological reasonable cluster, and then reduce the clustering threshold, so that the uncovered nodes more easily form a cluster.

G. LEACH-SI protocol

Since most routing protocols for wireless sensor networks is simple in design, easy to attack, attack methods mainly have the following several kinds of [14]: false routing information attack; selective forwarding ( selective forwarding ) attack; attack Sinkhole; Sybil Wo hole attack; attack; HELLO flood attacks; confirmation of Deception ( Acknowledgement spoofing ) attack. Several typical WSN routing protocol may be subject to attack type is shown below in table [12-14]:

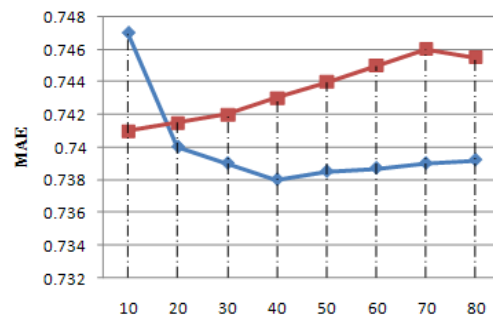


Figure 2 Several typical WSN routing

The LEACH protocol is susceptible to three types of routing attacks: selective forwarding attack, attack of Sybil and HELLO flood attack.

Here, the above mentioned hierarchical routing protocol and a three planar routing protocol flooding, DD, SAR comparison, derived table 2 as [1, 14]:

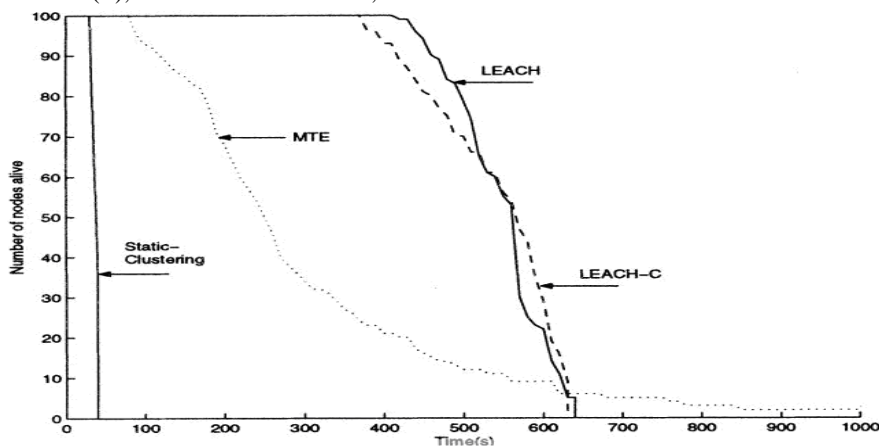


Figure 3 Comparison of routing protocol

## V. SUMMARY

In the cluster-based routing protocol design, can from the following 3 angles to further solve the WSN cluster routing problem [4, 14]

(1) in the cluster head selection, considered more effective cluster head selection algorithm and cluster head load balancing algorithm. The energy is not selected cluster head constraint factors, complex in a particular application, we must also consider the position of the node, to the base station, the distance calculation ability and mobility, especially the Actuator node application.

(2) in the cluster formation process, considering the reduction of topology generation process in the control message and reduced topology change frequency, reduce the communication overhead. How to use WSN distributed characteristic to build more efficient heuristic mechanism, through the node and the interaction between the information feedback to clustering, is currently the focus of research a direction. Combined with the specific network dynamics, design reasonable cluster of reconstruction of frequency, decreasing cluster maintenance overhead.

(3) design with plane structure and cluster structure advantages of a new type of data transmission mode. This protocol can effectively manage network topology structure, good processing mobility of nodes, but also can effectively use energy to transmit the data. Furthermore, how the cluster and the cluster data fusion and processing, but also very worthy of exploration.

(4) in the new network application, service quality has become an important indicator, so the wireless sensor network routing protocol for QoS requirement is more and more urgent. Table SAR protocol is a, now a lot of people committed to the QoS routing protocol design. Several typical routing protocols are: the wireless sensor network based on QoS adaptive clustering algorithm ( QoS-based adaptive clustering algorithm, QAC) [4], two stage clustering adaptive clustering algorithm (two-phase cluster formation algorithm, TCF) [4], K-means based energy balance consumption clustering algorithm schedule clustering algorithm (dynamic, DSCM[4].

Wireless sensor routing technology in ad hoc network occupies a very important position, there are still a lot of problems remain to be researchers to solve.

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