Adaptive　periodic　polling　for　neighbor　discovery　in　Wireless　Sensor Networks

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**Abstract**—我们研究的如何发现邻居节点,我现在的想法能不能开始统计一下邻居节点个数,如果发现找不到这么多邻居了,就再发消耗找, 邻居数量变化多就多找,领导没什么变化就少找. 邻居有新加的,也有确实减少的, 因而要时态调整. 另外一个是能不能利用远sink区域节点的剩余能量做点事情? 多发现? 发现时, 邻居节点之间动态轮流发现,而不是每个节点都去发现, 让发现节点多的节点处于不去发现, 而找邻居节点少的节点自己主动去找,这样找的节点的个数少, 让少数节点适应多数节点. 节省能量.

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**Index Terms**—Wireless sensor networks; routing; Delay; Duty cycle; Lifetime

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# 1 Introduction

The rest of this paper is organized as follows: In Section 2, the network model and problem statement are presented. Then, the ODC-SFS scheme is introduced in Section 3. Performance analysis of ODC-SFS presented in Section 4. Finally, Section 5 provides conclusions and future works.

# 2. Related work

Wireless sensor networks (WSNs) are often deployed in battles, fire-prone areas, rare animal protection, monitoring of emergency, etc. [22, 23]. In such application scenarios, sensory data are valid only in limited time duration, hence, the information obtained by sensor node needs to be delivered as fast as possible, otherwise it may incur significant damage and disaster [9, 22, 23]. Therefore, lots of researches are trying to achieve satisfactory delay requirement of data transmission as well as the tradeoff between delay and other network performance (like, lifetime, energy, efficiency) [5].

2.1. Research on lifetime

2.2. Research on Delay Optimization

In WSNs, data is transmitted to Sink by a certain routing scheme.

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2.3. Research on reliability

# 3 System Model And Problem Statement

## The network model

We consider that homogenous sensor nodes and one sink node deployed in a WSDSN. The sink node is regarded as the base stations, means the base station. The network can be regarded as . is the node ID. Those sensor nodes deployed in the target area such as environment monitor, industrial field, smart field and so on [23, 24, 25]. The network radius is , the transmission radius of a sensor node is . The sensor nodes are powered by battery whose energy are limited, and the energy of the sink is unlimited. Fig. 1 shows the initial connectivity setup of the network or the weighted graph established by a routing protocol. The network structure studied in this paper is given in the Fig. 1, is the center of data collection. is the sensor node in the network.



Fig. 1 Network structure diagram

In consequence of saving energy, it would be better that nodes are set to sleep-wake when nodes don’t need to receive program codes. Each node adopts asynchronous duty-cycle model, the duty cycle starts over between two consecutive periods. Each node has active/sleep two models. Each working cycle is divided into time slots with same length. Thus, one working cycles can be expressed as {0, 1, 2, 3,…..,} time slots. It is shown as Fig. 5, considering working cycle of a node is 3, the working cycle is regarded as three time slots, they are 0, 1 and 2. Each node randomly selects active time slots. is the sink node, the sink node sends program codes to neighbor nodes, then the program codes are transmitted from those neighbor nodes to outside nodes, until program codes reach the network boundary. The number in nodes are active time slots of nodes. Energy Consumption Model

In this paper, nodes can periodically switch on and off according to a normalized duty cycle. The energy consumption of a node contains three aspects. (1) The energy consumption for receiving data packets, (2) the energy consumption for sending data packet, (3) When node at m away from the sink is in the sleep state, the energy consumption of node for sensing message is , the energy consumption for sensing data in different schemes are the same. When node at m away from the sink is in active status, the energy consumption of node is , and the energy consumption of node at m away from the sink is when node sends program codes to neighbor nodes. Thus, the total energy consumption of node at m away from the sink is as follows.

(1)

Thus, the power consumption of node contains (1) The power for receiving packets , (2) the power for sending packets . Thus the energy consumption at node at m away from the sink is as follows.

(2)

is the amount of receiving data of node at m away from the sink, is the amount of sending data of node at m away from the sink.

The main parameters of system model adopted in this paper are similar to those parameters in [26, 27, 28]. The parameters are adopted in Table 1.

Table 1 Main notations and values adopted in this paper

|  |  |  |
| --- | --- | --- |
| Symbol | Description | Value |
|  | Duty cycle | Calculation-specific |
|  | Working cycle | 250ms |
|  | The power used by a node to receive a packet; | Calculation-specific |
|  | The power used to transmit an alert packet | Calculation-specific |
|  | Transmission power consumption | 0.0511W |
|  | Reception power consumption | 0.0588W |
|  | Preamble duration | 0.26ms |
|  | Ack window duration | 0.26ms |
|  | Packet duration | 0.93ms |

## The problem statements

**Definition 1:** Minimization network updated delay. The network updated delay is refer to the time for transmitting program codes from the base station to all nodes in the network. The aim of this paper is to reduce network updated delay, it can be calculated as follows.

(3)

**Definition 2:** Minimization broadcast times. Broadcast time is refer to the number of transmission when program codes are transmitted to the whole network. When nodes transmit program codes to neighbor nodes, the neighbor nodes can receive program codes only when nodes are in active statues. The aim of this paper is to reduce the number of transmission by increasing duty cycle of nodes far from the base station. The minimum broadcast times is expressed as follows.

(4)

**Definition 3:** Maximization of network lifetime (denoted as ). The fundamental purpose of application is to maximize network lifetime [29, 30, 31]. Network lifetime can be defined as the time of the node that dies first. For after the first node dies, it may affect the connectivity and coverage of the network severely leading the network cannot play a proper role. Thus, network lifetime in this paper is the time of the node that dies first. The energy consumption of node contains the energy consumption for receiving data packet, the energy consumption for sending data packet and the energy consumption for sensing data . Where represents the initial energy of node . Thus, network lifetime is as follows.

(5)

**Definition 4:** Maximization of effective energy utilization rate (denoted as ). refers to the ratio of energy efficiently utilized to the total energy of nodes in the network. The aim in this paper is to make full use of energy left in nodes far from the sink, then maximize energy utilization of the whole network. is the energy consumption of node , represents the initial energy of node . Thus, the effective energy utilization rate is as follows.

(6)

Obviously, the goal of ADCFD is to minimize delay, , minimize broadcast time, , maximize the network life, , and effective energy utilization, , which can be summarized as follows.

(7).

# The design of RDMT scheme

## 研究动机



每个节点初始active slot

## 4.2时隙调整的算法



**Fig. 9.** Case 1 in finalizing backbone

**Fig. 10.** Case 2 in finalizing backbone

(2) 紧接着, a self-adaption DCCOR scheme is proposed to 进一步提高网络性能.In self-adaption DCCOR scheme,在远sink能量有剩余的区域增大节点的占空比,从而能够在不降低网络寿命的前提下减少网络delay.

## 4.3自适应学习而使节点duty cycle分组的方法

后,我们提出了自学习的duty cycle调整方法,节点自适应的调整自己的duty cycle, 使邻居节点内节点同时awake的数量最接近预定的阀值.这样使得当sender 发送数据时,满足同时有个receiver awake所需要的等待时间变小,也就是有效的进一步减少了delay.



One hop delay VS cyc\_length τ



Fig. 7 Service caching and request response

caching process can be described by Algorithm 3.

|  |
| --- |
| **Algorithm 3:** Caching new service in CR |
| 1: Max\_time=0, Del\_index=NULL  2:**For** each New\_Serv of **Do**  3: **If** Res\_Store>New\_Serv.Size **then**  4: **Loop**: Divide New\_Serv into *M* content chunks  5: Cache *M* content chunks locally  6: Insert a statement “;New\_Serv.ID; C[1], C[2], …, C[M]; New\_Serv.Size” into Service Caching Table  7: **End if**  8: **Else**  9: **For** each service caching in **Do**  10: **If**Max\_time<.N\_time and .Size>New\_Serv.Size**then**  11: Max\_time=.N\_time  12: Del\_index=.ID  13: **End if**  14: **End for**  15: Remove S[Del\_index] from the storage of  16: **Goto** Loop  17: **End else**  18: **End for** |

After

# 4 Analysis of experimental results

## 4.1 Experiment Setup

Experimental scenario is as follows:

## 4.2 实验一

# 5 Conclusion

The

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