Sensor Network Media Access Design

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1 ABSTRACT

Wireless Sensor Applications work on low power networks based on Specified Media Access Control mechanisms. Many techniques have been proposed to lower consumed power and avoid collisions. We proposed an improved B-MAC mechanism suitable for variable environmental noise.

2 INTRODUCTION

Wireless sensor networks helps us build a networks control hundreds of sensor monitors, vidicons and etc. In this paper, we discuss a backoff mechanism can adjust signal intensity along with huge environmental changing. To provides effectively communication, signal intensity must be stronger than noise intensity. While considering longer lifetime of sensor nodes, the signal intensity should be regulated in a relatively low level. When noise floor is varied in a big range, the signal intensity should revise with the noise floor.

We design a function which measure the RSSI and an adjusted mechanism like BMAC and XMAC. Except target address in preamble, we include information of estimated transmitting time. Thus, other node can avoid unnecessary detection and saves energy.

3 RELATED WORKS

Lots of new MAC protocols have been worked out by researchers before shown in figure 1. Here are some introduction about prevalent protocols named: SMAC, TMAC, XMAC and BMAC.

SMAC is a low-powered single-frequency contention-based MAC protocol that uses loose synchronization. Nodes have duty cycling in sensor networks. The RTC-CTS based protocol uses periodic sleep, virtual clustering, and adaptive listening to save energy. The nodes in the network periodically wake up, receive and transmit data, and return to sleep. At the beginning of the awake period, a node exchanges synchronization and schedule information with its neighbors to assure that the node and its neighbors wake up concurrently. Although, SMAC saves more power than 802.11, it does not adapt to network traffic very well since it uses a fixed duty cycle for all the sensor nodes. TMAC improves the design of S-MAC by shortening the awake period if the channel is idle.

BMAC, developed by J. Polastre at the University of California at Berkeley, is a CSMA-based technique that need low power supply and mechanism of awake-and-asleep. He proposed the initial and congestion backooff algorithm of primary concern in achieving high channel utilization in CSMA schemes. The initial backoff affects the maximum load that each node may offer to the channel. An appropriate congestion backoff algorithm for wireless sensor networks aimed at minimize the amount of time the node is powered.

XMAC, which employs a short preamble to further reduce energy consumption and to reduce latency. The first idea is to embed address information of the target in the preamble so that non-target receivers can quickly go back to sleep. This addresses the overhearing problem. The second idea is to use a strobed preamble to allow the target receiver to interrupt the long preamble as soon as it wakes up and determines that it is the target receiver. This short strobed preamble approach reduces the time and energy wasted waiting for the entire preamble to complete. XMAC provides these advantages: X-MAC introduces a series of short preamble packets each embed target address information, thereby avoiding the overhearing problem of low power listening, and saving energy on non-target receivers. X-MAC inserts pauses into the series of short preamble packets, creating a strobed preamble, which enables the targeted receiver to shorten the strobed preamble via an early acknowledgement, thereby achieving additional energy savings at both the sender and receiver, as well as a reduction in per-hop latency. We describe an adaptive algorithm for automatically adjusting the duty cycle of receivers to the offered traffic load, which further reduces per-hop latency. Experimental evaluation validates the performance gains and energy savings of the X-MAC protocol in comparison to a traditional asynchronous duty cycle techniques.

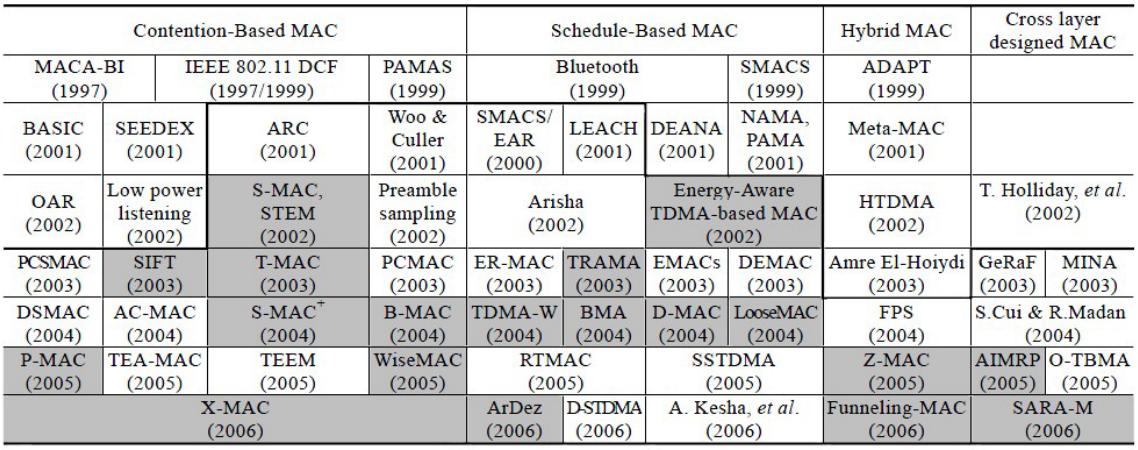

Figure 1: MAC protocols for wireless sensor networks[3]

4 New MAC protocol design

In XMAC, the author decrease unnecessary energy waste due to preamble and continue sending massage to receiving node without repeated preamble. However, other connected node are still detecting the channel. Actually, in this period, detection is useless since other node cannot receive or transmit any packet in case of collision.

We add more information into the preamble: the estimated transmitting time required. The sender will calculate the transmitting time required. The sender will evaluate how many (count1) duty-and-sleep circle that the transmitting time equals to.

$count1 = \frac{thetransmittingtime}{duty-and-sleepcircle}$

The Sender send an preamble packet consists of target address information and estimated transmitting time. Every node which can received the packet can determined whether they are the destination node. IF the target node received the packet in the awake period, it will send an early ACK and then keep the receiving part open and then receive the packet. If the non-target node received the packet in the awake period, it will then closed the detection function for a time of $count1$ times of duty and sleep periods indicated by the preamble.(Shown in figure 2)

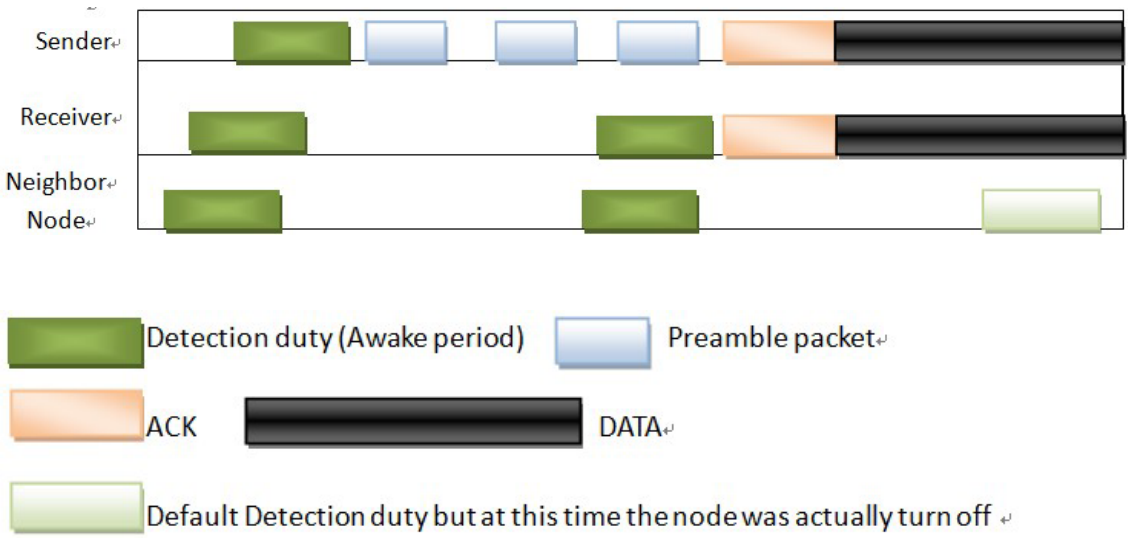

Figure 2: Extended XMAC approach

Hence in addition to shortening the preamble by use of the acknowledgement, when data transmitting, the non-sender and non-receiver node will be asleep and save energy more than in duty-and-sleep circle. After transmitting end, the neighbor node of sender and receiver will continue their duty-and-sleep circling. If bulk data are transmitted, this mechanism will save much energy since the transmitting periods are long and the neighbor node will keep asleep.

The other neighbor node of the sender will possible receive the preamble information which contains the destination address. Other node will keep the preamble information. If these nodes want to send the information to the same receiver, after the $count1$ times of duty-and sleep circle, they will detect the channel and evaluate the RSSI. And after a random short time due to collision avoidance, it will begin sending.

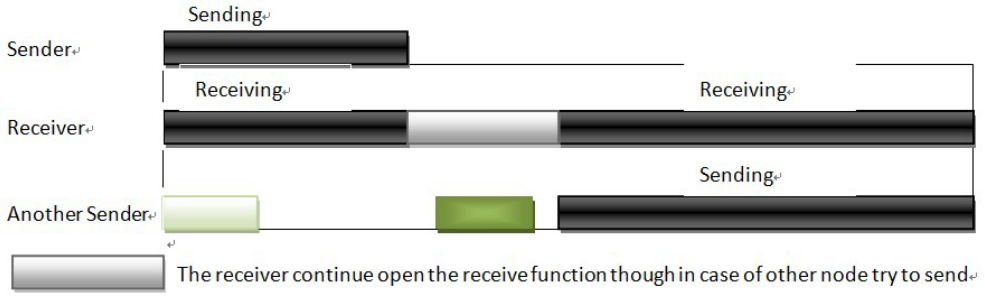

Figure 3: Continue sending to the same destination

5 RESULTS

In this MAC protocol, the node power consumption are ameliorated then XMAC in some situation. First, when the average data transmitting time is relatively short: the power consumption is more or less the same as the XMAC for reasons that the reduced Detection time are not considerably canceled. Secondly, when the average data transmitting time is relatively long compared to duty period: the power consumption are greatly reserved for reasons that the unnecessary detection are greatly canceled.

6 CONCLUSION

This MAC protocol take the advantages of abolish redundant detection. This mechanism take use of DFWMAC-DCF w/RTS/CTS. Moreover, this mechanism is specified to WSN and more suit WSN than traditional MAC protocol. Considering the tradeoff between long data transmitting time and short data transmitting time, this mechanism take use of information of time and thus better improve the scheme of detection. By considering the detection period, this protocol take fewer detection. As a result, the delay maybe need a further consideration.

7 REFERENCES

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