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A Novel Approach for Event Monitoring In Wsn Using Sleep Scheduling

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Abstract *: A broadcasting delay is an important problem for the application of the critical event monitoring in wireless sensor networks. To prolong the network lifetime some of the sleep scheduling methods are always employed in WSNs it results in a significant broadcasting delay. A novel sleep scheduling method to be proposed it is based on the level-by-level offset schedule to achieve a low broadcasting delay in wireless sensor networks (WSNs). There are two phases to set the alarm broadcasting first one is, if a node detects a critical event, it create an alarm message and quickly transmits it to a center node along a pre-determined path with a node-by-node offset way. Then the center node broadcasts the alarm message to the other nodes along another predetermined path without collision. To eliminate the collision in broadcasting, a colored connected dominant set (CCDS) in the WSN via the IMC algorithm is established. An on demand distance vector routing protocol is established in one of the traffic direction for alarm transmission. The proposed system is used in military and forest fire application.*

Keywords *- Wireless Sensor Network (WSN), critical event monitoring, sleep scheduling, broadcasting delay.*

I. INTRODUCTION

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure ,intruders etc., and to cooperatively pass the data through the network to exact location. The modern networks are bi-directional and it also enabling control for sensor activity. Monitoring is a common application for WSNs. The WSN is deployed over a region where some phenomenon is to be monitored. This can be applied in the field of military where they use sensors to detect intruders. When the sensors detect the event being monitored, the event is reported to one of the base station then it takes appropriate action.

As sensor nodes for event monitoring are expected to work for a long time without recharging the batteries, sleep scheduling method is always used during the monitoring process. Recently, many sleep schedules for event monitoring have been designed. However, most of the techniques focus on minimizing the energy consumption. A small number of packets need to be transmitted during critical event monitoring. If any event is detected the alarm packet should be broadcast to the entire network. Therefore, broadcasting delay is an important problem for the application of the critical event monitoring. Here, unauthorized user enter into the network (or) misbehavior nodes in network that node is a critical node these event are detected by the any sensor node in WSN.

In view of wake-up patterns, most sleep scheduling schemes can be categorized into two kinds:
(1) Synchronous wake-up pattern.
(2) Asynchronous wake-up pattern.

Sleep scheduling is a usual way for power management to save energy. Lots of works have studied it in WSNs, which can be classified into two main categories: 1) determined transmission pattern; 2) dynamic transmission pattern. In the first category, nodes periodically wake up and transmit at the determined time in each duty cycle, and time synchronization is always assumed. While, in the second category, nodes wake up and transmit at variation time in each duty cycle according to current traffic and time synchronization may not be needed. Among these works, most of them try to keep nodes sleeping as long as possible, while seldom study when nodes need to wake up to reduce the transmission delays. In other word, power saving is the main concern instead of transmission delay.

To minimize the broadcasting delay, it is needed to reduce the waiting time during the broadcasting. The best scenario is the destination nodes wake up immediately when the source nodes obtain the broadcasting packets. Based on this idea, a level-by-level offset schedule is proposed. Hence, it is possible to achieve low transmission delay with node-by-node offset schedule in multi-hop WSNs. It is still a challenge for us to apply the level-by-level offset to alarm broadcasting in the critical event monitoring. Initial the order of nodes wake-up should be conformed by using the traffic direction. If the traffic flow is in the opposite direction the delay in each hop will be as large as the length of the whole duty cycle. Second the level-by-level offset employed by the packet broadcasting could cause a serious collision. Through designing a special wake-up pattern the two possible traffic paths could be carried by a node.

Paper Organization

This paper is organized as follows: Section 2 introduces Related work. Section 3 introduces Problem definition and system architecture. Section 4 presents proposed scheduling method. Section 5 presents experimental result. Section 6 gives conclusions and directions for future work.

II. Related Work

A centralized gateway node collects all transmission requirements during a contention period and then schedules the distributions according to the reservation path. An energy-adaptive MAC protocol, Gateway MAC (G-MAC) implements a new cluster-centric paradigm to effectively distribute cluster energy resources and extend network lifetime. Concentrating the transmissions into a smaller active period reduces idle listening, but it also increases the probability of collisions. Receiving and discarding messages intended for other nodes, or message overhearing, is commonly employed in non-energy constrained networks to increase throughput and high delay [5].

Continuous monitoring applications are an important class of wireless sensor application. These application require periodic refreshed data information at the sink nodes [9]. The need of the sensor node was to transmit continuously in periodic fashion to the sink nodes it leads to excessive energy consumption.

DMAC protocol specifically design for the wireless sensor network, where the communication pattern is restricted to an established unidirectional data gathering tree. Here, all nodes having a periodic receive–transmit sleep cycle with level-by-level offset schedule ,which means that all nodes wake up when the source node have just gotten a data packets, and go to the sleep as soon as they transmit packets to the destination nodes. The level-by-level offset schedule in DMAC can achieve much lower transmission delay in one traffic direction. it is not efficient in bidirectional delay guarantee [2].

The authors presented several sleep scheduling patterns that adhere to the bidirectional end-to-end delay constraints, such as shifted even and odd pattern, ladder pattern, two-ladder pattern and crossed-ladders pattern. However, the patterns are not suitable to alarm broadcasting in the WSN, because the traffic discussed is just a single flow. If the sink node broadcasts packets according to the patterns, there will be serious collision in the network [6].

In this query based sensor network a node cannot voluntary send data packets that they sensed to the sink node, unless the sink node sends them queries, these queries are very complex. Hence the sink node needs to predict the data arrival time for each destination nodes. Collecting information from the environment by keeping all the nodes active and transmitting to the sink is energy expensive. Therefore, the scheme is not suitable to alarm broadcasting in the WSN for critical event detection [4].

ADB is based on asynchronous wake-up. It exploits some information contained in data packets and ACK, so to arrange the transmission among nodes. When sensor nodes take prior knowledge of all the link quality, packet broadcasting in ADB actually follows a determined broadcasting tree in the network. Furthermore, as sensor nodes with ADB wake up asynchronously, collision can almost be avoided. In this technique, to compare the proposed scheduling scheme with ADB [8] and DW-MAC.

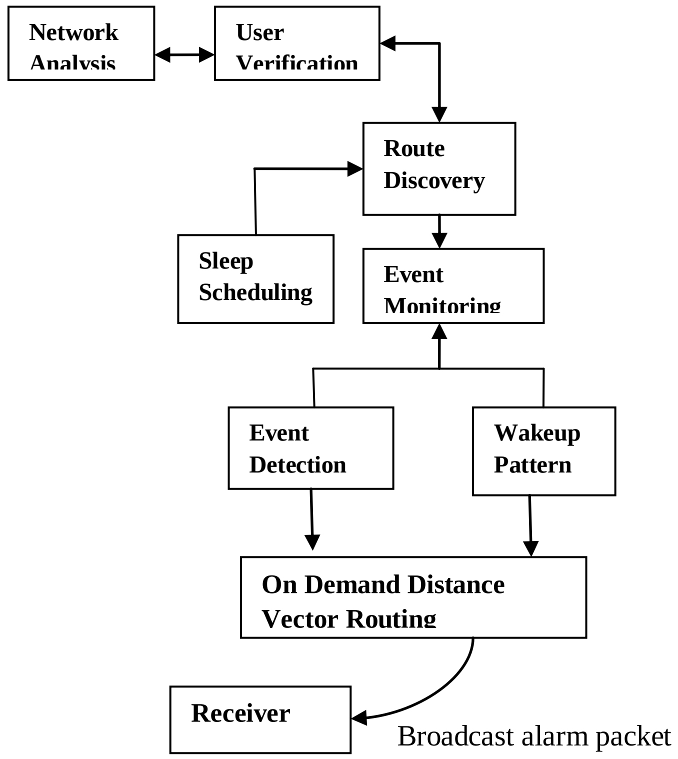
III. Problem Definition And System Arichitecture

A. Problem definition

The critical event monitoring in a WSN, sensor nodes are usually set with passive event detection capability and it allow a node to detect an event even when its wireless communication module is in sleep mode. Upon the detection of an event by the sensor, the radio part of the sensor node is immediately woken up and is ready to send an alarm message. The time is partition into different time slots. The length of each slot concerning the minimum time is needed by sensor nodes to transmit or receive a packet, which is denoted as τ.

To assume the network topology is steady and denote it as a graph G. time of sensor nodes in the proposed scheme is assumed to be locally synchronous, which can be implemented and maintained with periodical beacon broadcasting from the center node.

B. System Architecture



IV. The Proposed Sleep Scheduling Method

The proposed scheduling method includes two phases: 1) any node which detects a critical event sends an alarm packet to the center node along a predetermined path according to level-by-level offset schedule; 2) the center node broadcasts the alarm packet to the entire network also according to level-by-level offset schedule. define the traffic paths from nodes to the center node as uplink and define the traffic path from the center node to other nodes as downlink.

i)Traffic Paths

To choose a sensor node as the center node c. The Breadth First Search (BFS) tree is establish in uplink traffic to find the shortest path from sensor node to the center node. To construct the BFS tree which divides all nodes into layers H1, H2, H3; . . .;HD, where Hi is the node set with minimum hop i to c in the WSN.

A Colored Connected Dominant Set (CCDS) is established in downlink traffic for reduce the broadcasting delay. To establish the CCDS in G with three steps:

1) Construct a maximum independent set (MIS) in G.
2) Select connector nodes to form a Connected Dominated Set (CDS), and partition connector nodes and independent nodes in each layer into four disjoint sets with IMC (Iterative Minimal Covering) algorithm proposed.
3) Color the CDS to be CCDS with no more than 12 channels.

ii) Wake-up Patterns

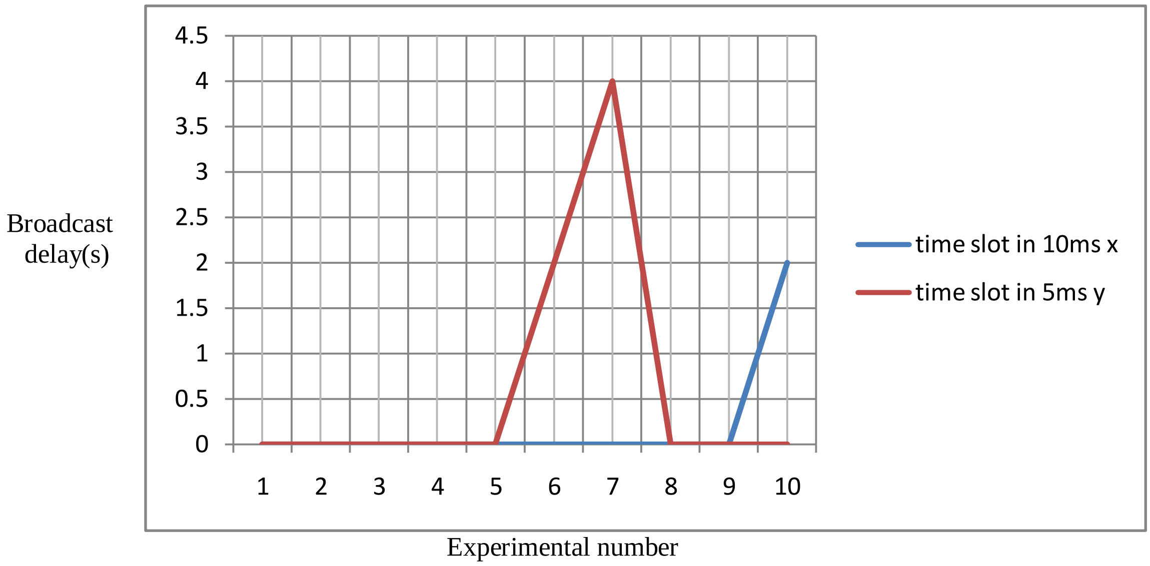
Wake-up pattern is needed for sensor nodes to wake-up and receive alarm packet to achieve the minimum delay for both of the two traffic paths. the two level-by-level offset schedules: 1) sensor nodes on paths in the BFS wake up level-by-level according to their hop distances to
he center node; 2) after the center node wakes up, the nodes in the CCDS will go on to wake up level-by-level according to their hop distances in the CCDS.

In odd duty cycles the sensor nodes which are in $H2mL+i$ wake up level-by-level along the uplink traffic paths in channel $ch1$. When the center node wakes up, it is just at the beginning of even duty cycles. Then the nodes in $H'(2m+1)L+i$ in CCDS wake up level-by-level along the downlink traffic paths in their receiving channels.

V. Experimental Evaluation

This experiment shows that our proposed method could be used in real wireless sensor network for monitor the event and it will reduce the broadcasting delay. We first set the size of the time slot to be the minimum time for sensor nodes to transmit an alarm packet, e.g., 2 ms. When an alarm transmission fails between two adjacent nodes with the proposed scheme, the sender node has to retransmit the alarm after 2 duty cycles. In graph 1, the red line stands for results when time slot is $5ms$, and the blue line stands for results when time slot is $10ms$. It can be seen, the proposed scheme achieves very low broadcasting delay ($0.06s$) in most of the experiments when time slot is $5ms$.

Graph 1: Performance Impact



VI. Conclusion

The sleep scheduling technique is used to detect and monitor the critical event that occurs in wireless sensor network. This can be done by predetermining the route and synchronous wakeup pattern. The upper bound of the delay is 3D + 2L, which is just a linear combination of hops and duty cycle. Moreover, the alarm broadcasting delay is independent of the density of nodes in WSN. The broadcasting delay and the energy consumption of the proposed scheme are much lower than that of existing methods. In future sleep scheduling method can be used to broadcast multiple alarm without collision .

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