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Critical Event Monitoring using Sleep Scheduling in Wireless Sensor Networks

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ABSTRACT—
Broadcasting delay is a major issue for critical event monitoring application in WSN. Sleep scheduling technique is always used to employee in WSN to improve the lifetime of wireless sensor networks which leads in significant increment in broadcasting delay. To reduce the broadcasting delay, a sleep scheduling method with level by level offset schedule needs to be used. There are two phases to set the alarm broadcasting first one is, if a node detects a critical event, it will immediately transmit an alarm to a centre node through predetermined path with node by node offset way. Then in second phase, this centre node broadcasts the alarm to all other nodes along another predetermined path without collision. A colour-connected dominant set in WSN is established to eliminate the collision.
Keywords— Wireless Sensor Network (WSN), critical event monitoring, sleep scheduling, broadcasting delay.

I. INTRODUCTION (HEADING 1)

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions such as sound, pressure, temperature, 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 their batteries, the 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) misbehaviour 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. Whereas, 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 wakeup should be confirmed 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. Secondly, 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. One is for uplink traffic (i.e. centre node to other node) and another is for downlink traffic (i.e. node to centre node). In this paper, we propose shortest path algorithm which reduces the broadcasting delay as compared to level by level offset schedule.

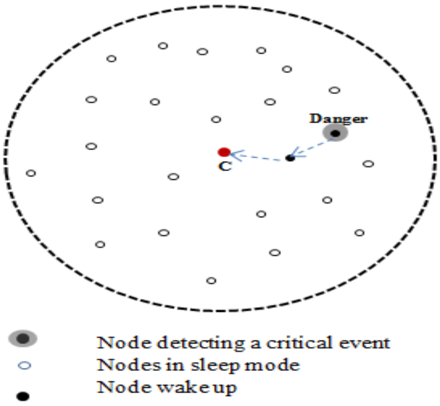

Fig. 1 Critical Event monitoring

I. PROBLEM DESCRIPTION

Initially, we assume that a center node in the network has obtained the network topology (e.g., sink node). This center node computes the sleep scheduling sequence according to the proposed scheduling scheme and broadcasts the scheduling to all the other nodes. The following terms are plays an important role in this paper.

•**Event detection:** For the critical event monitoring in a WSN, sensor nodes are equipped with passive event detection capabilities that 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 sensors, the radio module of the sensor node is immediately woken up and is ready to send an alarm message.

•**Slot and duty cycle:** Here, the time is partitioned into time slots. The length of each slot is the minimum time needed by sensor nodes to transmit or receive a packet, which is denoted as τ. The length of each duty cycle is given as $T=L*\tau$, i.e., there are L slots in each duty cycle.

•**Network topology:** For understanding purpose, we assume that the network topology is steady and is denoted as a graph G.

•**Synchronization:** In the proposed scheme, time of sensor nodes is assumed to be locally synchronised, which can be implemented and maintained with periodical beacon broadcasting from the center node.

II. PROPOSED SCHEME

After nodes are assigned sending channels and receiving channels, wake-up pattern is needed for them to wake up and receive the possible alarm packet to achieve the minimum delay for both uplink traffic and downlink traffic.

When a node detects a critical event, as shown in Figure 2, the node will wait until its wake-up time slot for uplink traffic arrives. Then, it transmits an alarm packet to its center node at the center node's wake-up time slot. In this way, the alarm can be relayed along the uplink traffic path with nodes waking up level-by- level, till to the center node. Then, the center node broadcasts the alarm packet along the downlink traffic paths in CCDS with nodes just waking up level-by-level. The alarm packet is transmitted in channels according to the node's receiving channels. It can be seen that the broadcasting will not cause any collision.

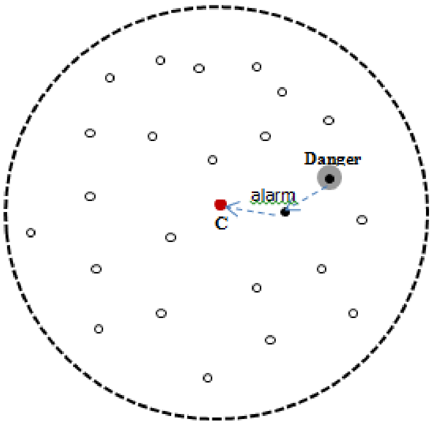

Fig. 2 node transmitting alarm to centre node

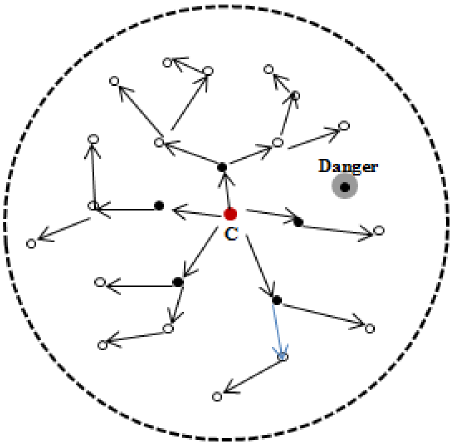

Fig. 3 Center node broadcasting alarm packets to all other nodes

III. PERFORMANCE EVALUATION

Here we used the network simulator NS-2 to analyse the performance of combined level-by-level offset schedule in comparison with shortest path algorithm on the basis of certain performance parameter such as energy and delay .We perform the set of experiments for simulation area which is square of 300m * 300m using NS-2.nodes are able to communicate with each other using the IEEE 802.11 MAC layer. All the simulation results are taking by varying the number of nodes in the network from 10-50 nodes for the energy and delay of the network in case of level-by-level offset schedule and shortest path algorithm. The simulation parameter settings are given in following table.

TABLE 1: SIMULATION PARAMETER SETTINGS

Parameters	Values
Simulator	NS-2
Area	300m*300m
No. Of Nodes	10-50
Packet size	1000 bytes
MAC protocol	IEEE 802.11
Transmission Range	40 m
Frequency	300 MHz
Bandwidth	60 MHz
Protocol	DSDV

IV. RESULT:

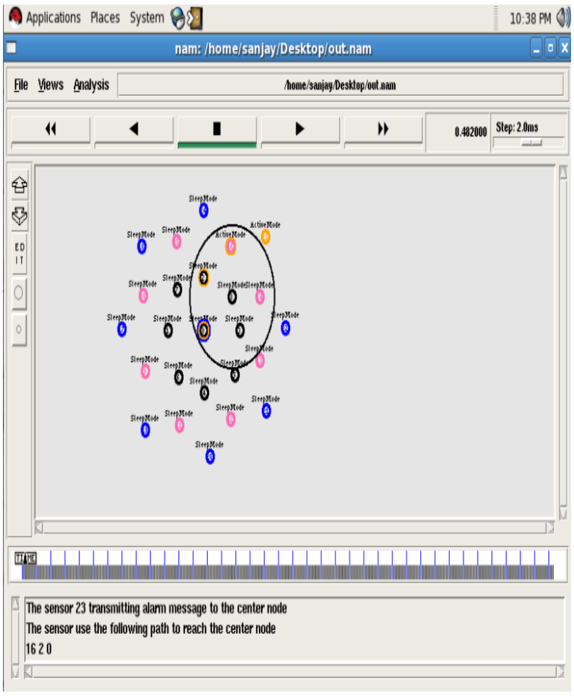

Fig. 4. Node 4 detecting a critical event & sending alarm to center node

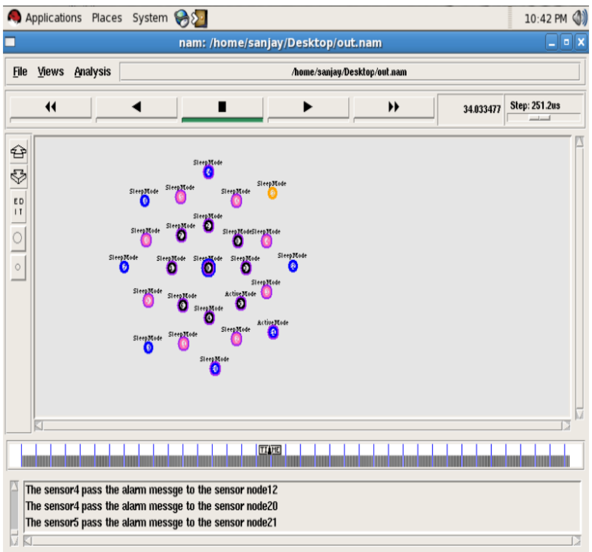

Fig. 5 Alarm is broadcasting from center node to other nodes.

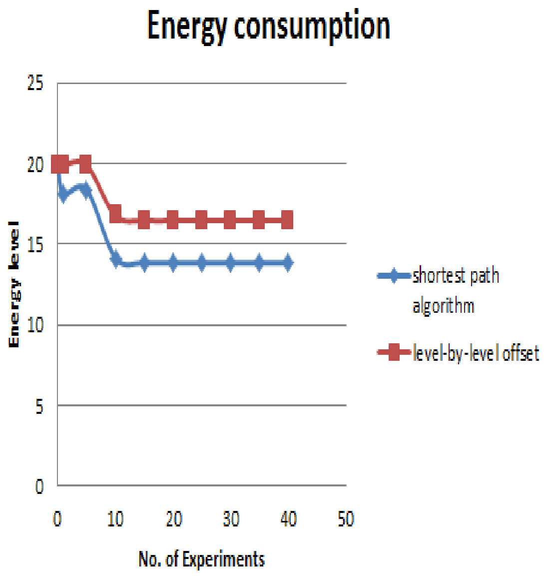

Fig. 6. Comparison of energy consumption in shortest path algorithm and level by level offset schedule

V. CONCLUSION

From all the above results, it is clear that broadcasting delay is getting reduced, if shortest path algorithm is used instead of level- by- level offset schedule. Again energy consumption is also get reduced with the help of sleep scheduling method.

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