International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 2, February- 2013

Optimizing Delay For Critical Event Monitoring In Wireless Sensor Networks

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Abstract- This paper proposed to monitor a critical event in wireless sensor networks. Whenever a critical event occurs, the critical event is detected by the nearby sensor nodes. Immediately these sensor nodes should broadcast an alarm message to the entire network. Sleep scheduling is used to reduce the energy consumption which is leads to increase network lifetime. But it leads to the broadcasting delay, especially in large scale WSNs. So we need to balance both energy efficiency and delay aware. In this paper, we propose a delay optimized sleep scheduling method to reduce the delay of alarm broadcasting in WSNs. When a critical event occurs, an alarm is immediately transmitted to a center node, and then it is quickly broadcasted by the center node to the entire network without any collision.

I. INTRODUCTION

A may number of sensor nodes which is used for detecting and reporting some important information to the end-users are deployed in a wide range of areas. When a critical event occurs such as gas leak in factory or fire in the forest is detected by a sensor node, an alarm needs to be broadcast to the other nodes as soon as possible. Sleep scheduling method is always used during the monitoring process to reduce the energy consumption [4], [5] so that the sensor nodes for event monitoring in wireless sensor networks are expected to work for a long time without recharging their batteries.

In sleep scheduling, sender nodes should wait until receiver nodes are active and ready to receive the message. Sleep scheduling should increase the network life time but it could cause transmission delay [6], [8]. Whenever the network scale increases, the broadcasting delays also increase. So a delay aware sleep scheduling method needs to be designed to provide low broadcasting delay from any node in the WSN.

Most of sleep scheduling methods in [1],[2],[3] focus to minimize the energy consumption. To minimize the broadcasting delay in WSN, it is needed to minimize the time wasted for waiting during the broadcasting. So we need to balance both energy consumption and broadcasting delay in wireless sensor network. The destination node is wake up immediately when the source nodes obtain the broadcasting packets. Here, the broadcasting delay is reduced.

Sleep scheduling in wireless sensor network is shown in fig. 1.whenever a critical event occurs, it is detected by the nearby sensor nodes and immediately it should sent to its neighbour nodes.

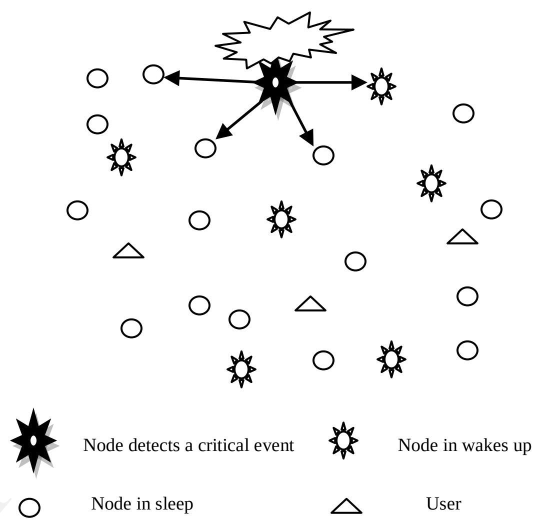

Fig. 1: Critical event monitoring with a WSN.

This paper is organized as follows. Section 2 includes a discussion on key concept of sleep scheduling and MAC protocol; section 3 includes a wake-up pattern and performance metrics and section 4 gives the conclusion on this paper

II. KEY CONCEPTS

A. SLEEP SCHEDULING

Sleep scheduling is probably the most efficient mechanism to increase the lifetime of energy constrained sensor networks. Sleep scheduling [7], [9] can be classified into two types such as, synchronized sleep wake scheduling protocol and asynchronized sleep wake scheduling protocol.

In synchronized sleep wake scheduling, each node knows exactly when its neighboring nodes will wake up. Then each node in wireless sensor network needs to exchange synchronization message with other nodes. It causes the additional communication overhead.

In asynchronized sleep wake scheduling, each sensor nodes wake-up independently. Each sensor node can only estimate when its neighboring nodes will wake up. It could result in a large delay than in the synchronized scheduling.

B. WAKE-UP PATTERNS

In sleep scheduling, most of the time nodes stay in low-power or sleep modes. But periodically waking up to check or monitor for activity. This increased longevity, however, comes at the cost of increased message delivery latency since a forwarding node has to wait until its next-hop neighbour awakens and is ready to receive the message. Current wake-up methods can be divided into two main categories:

1) Scheduled wakeups: In this class, the nodes follow possibly random wakeup patterns. Time synchronization among the sensor nodes in the wireless sensor network is generally assumed. However, asynchronous wakeup mechanisms which do not require synchronization among the different nodes are also categorized in this class. Although asynchronous methods are simpler to implement, they are not as efficient as synchronous schemes, and in the worst case their guaranteed delay can be very long.

2) Wakeup on-demand (out-of-band wakeup): It is assumed that the nodes can be signaled and awakened at any point of time and then a message is sent to the node. This is usually implemented by employing two wireless interfaces. The first radio is used for data communication and is triggered by the second ultra low-power radio which is used only for paging and signaling.

IV. EXISTING METHOD

In the proposed delay aware sleep scheduling method. First, a node which detects the critical event generates an alarm message and immediately transmits the alarm message to its neighbour node which is in activation mode. Finally the alarm message will reach the center node with a level-by-level offset way [9]. If the sensor node receives the same message in the same level then discard that message.

Then, the center node broadcasts the alarm message to the entire networks with a level-by-level offset way. Traffic paths from sensor nodes to the center node are known as uplink and the traffic path from the center node to other nodes is known as downlink, respectively. Each node needs to wake up properly for both of the two uplink and downlink traffics.

Construct a maximum independent set (MIS) in G.Select connector nodes to form a connected dominated set (CDS), and partition connector nodes and independent nodes in each layer into 4 disjoint sets with IMC algorithm Color the CDS to be CCDS with no more than 12 Channels Two independent nodes cannot be adjacent; the distribution of independent nodes is actually sparse. It has been proved that each independent node has less than 12 neighbours in I within 2-hop distance.

IV. PROPOSED METHOD

This paper proposes a backbone concept and multiple time slot concept to the existing method for energy and delay efficient. Each node in wireless sensor network has empty caches. At time t when the source initiates a route discovery, the available energy levels of the sensor nodes and their current required transmit power levels**.** The source initiates a route discovery by broadcasting the RREQ packet. Node are within the transmission range of node the available energy level and the required transmit power level of a node are taken into account while making routing decision. The subtraction of current available energy levels and the required transmit power levels of nodes indicate how likely these nodes will deplete battery energy source node finds a minimum energy route at time t such that the following cost function is maximized. Transmit power is recorded in the data packet by every node lying along the route from source to destination and it is forwarded to the next node.

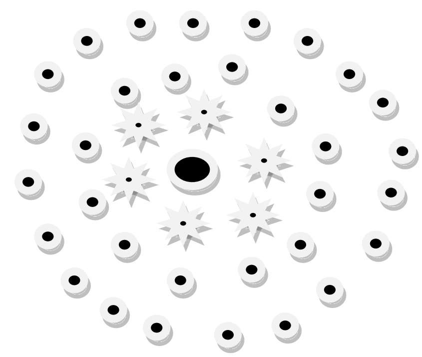

Fig 2a: level 0 nodes in wake-up mode

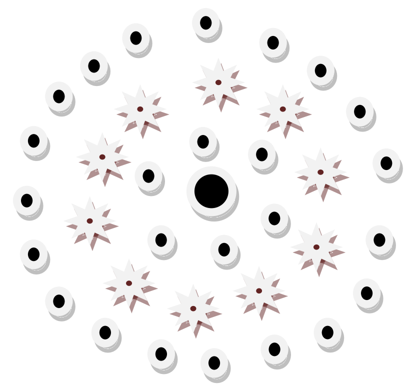

Fig2b: level 1 nodes in wake-up mode

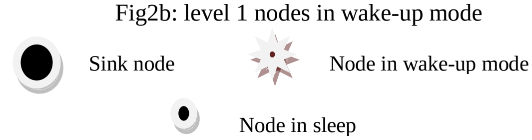

Fig 2: Level-by-level offset

A. DIFFERENT SIZE OF TIME SLOTS

The different size of the time slot to be set as minimum time for sensor nodes to transmit an alarm packet .When an alarm transmission fails between two nearby nodes with the proposed scheme; the sender node has to retransmit the alarm after 2 duty cycles. This scheme does not show good performance in the case of minimum time slot.

To improve the performance, we have to set the size of the time slot to be 10. Each sensor node still listens for 2ms during each duty cycle. When a sensor node wakes up to listen to the channel and detects a collision or a failing reception

ISSN: 2278-0181
Vol. 2 Issue 2, February- 2013

during the each duty cycle, it will keep listening and receiving till the end of this time slot. Accordingly, when the sender node finds that it fails to transmit the alarm packet during the 2duty cycle, it will keep retransmitting the packet till the end of the time slot. With this improvement, sensor nodes may successfully retransmit packets within a time slot and do not need to retransmit packets after 2 duty cycles. Hence, both transmission delay and broadcasting delay could be largely reduced.

B. BACKBONE CONCEPT

Wireless Sensor Networks are deployed for monitoring and controlling of systems where human intervention is not desirable or feasible. Compared with traditional computer networks, WSNs have no fixed or pre-defined infrastructure as a hierarchical structure, resulting the difficulty to achieve routing scalability and efficiency. These problems can be overcome by selecting some nodes as a Virtual Backbone [10] as shown in fig.3 for a network, in which only the links within this backbone and direct links from other nodes to the backbone nodes are mainly used in the WSN. Usually, we use a Dominating Set to serve as a backbone for a WSN, which is a subset of nodes in the network where every node is either in the subset or a neighbor of at least one node in the subset. For a backbone to be useful, it should be connected, namely, Connected Dominating Set.

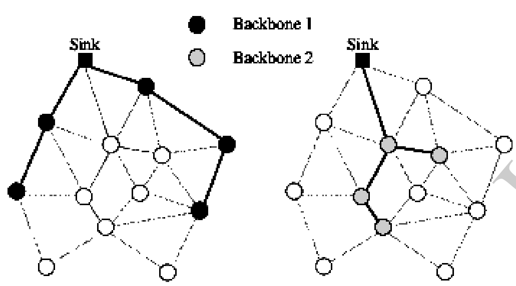

Fig.3: Backbone architecture

The nodes in a CDS are called either dominators, or, dominatees. In a WSN with a CDS as its VB, dominatees only forward their data packet to their connected dominators. Moreover, the CDS with the smallest size is called a Minimumsized Connected Dominating Set. In addition to routing, a CDS has many other applications in WSNs, such as data collection, broadcasting, topology control, coverage, and data aggregation. Clearly, the benefits of a CDS can be magnified by making its size smaller. Therefore, it is desirable to build an MCDS to reduce the number of nodes and links involved in communication.

V. RESULTS

The proposed technique has been simulated and the results are shown in the figure 4, 5. Fig 4 shows the ns-2 simulation for the broadcasting delay for critical event monitoring in various experimental results.

The number of packets that a source can transmit to n number of receivers can be calculated .Fig 4 shows the result for the broadcasting of packets from sink node to all sensor nodes in that wireless sensor network. Fig 5 shows the comparison of broadcasting delay for our proposed scheme, previous sleep scheduling method, DW_MAC, ADB.

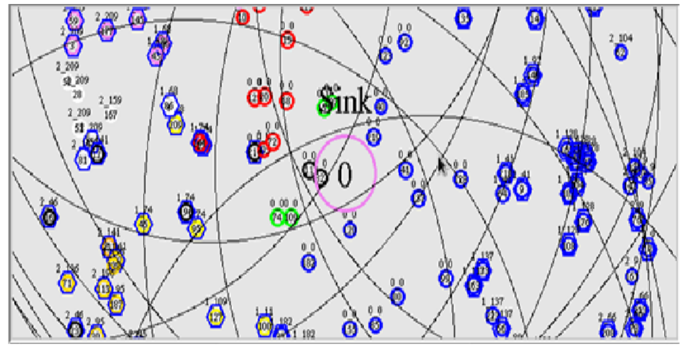

Fig 4: Centre Node Broadcast the Alarm

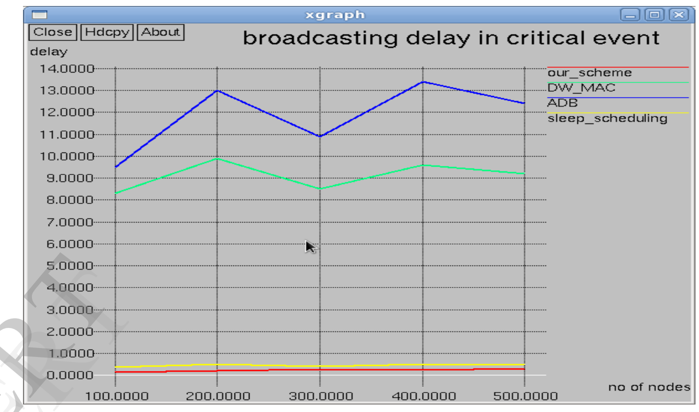

Fig 5: Average Delay

Fig 5 shows the result analysis for the transmission delay for alarm message. The source broadcasts the message to other nodes which are inside the network.

VI. CONCLUSION

This paper proposes a novel technique for critical event monitoring in WSNs. The proposed sleeping scheme decreases the notification delay of alarm broadcasting from any node. Multiple time slot concept reduces the waiting time to transmit or receive the alarm packets. Moreover, the alarm broadcasting delay is independent of the density of nodes in WSN. Theoretical analysis and conducted simulations showed that the notification delay and the energy consumption of the proposed scheme are much lower than that of existing methods.

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