SLEEP SCHEDULING FOR MINIMIZING THE ENERGY CONSMPTION AND LATENCY INDUTY-CYCLED SENSOR NETWORKS WITH INTELLIGENT HYBRID MAC

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ABSTRACT

The key objective of the project is to achieve energy efficiency under wide range of traffic load and also to guarantee the shorter latency for critical and delay-sensitive packets in the domain of wireless sensor network. The existing methods have some disadvantages such as local minimum problem, that is, if there is no nodes near destination, it will lead to dead end. Sink mobile (destination) information is flooded only on demand. In other words, WSNs mainly focus on two targets: point coverage, the awake nodes in each time interval are chosen to cover every point of the deployed field. For node coverage, awake nodes are selected to construct a globally connected network such that each asleep node is an immediate neighbour of at least one awake node. There comes the interference problem while sending data to the destination, if it has many neighbouring nodes. So, IHMAC (Intelligent Hybrid Medium Access Control) protocol can be used to overcome this problem. By using this protocol, all nodes can sleep and awake at the same time and in the same interval if is does not have any data. This protocol uses low power with quality of service guaranteed medium access control for wireless sensor networks.

Keywords: Intelligent Hybrid Medium Access Control (IHMAC), Wireless Sensor Network (WSN), Sleep, Awake

I. INTRODUCTION

WSN is a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. The wsn is made up of 100s and 1000s of sensor nodes which perform some processing, gathering sensory information and communication with other connected node in network. Each and every node is powered by a small battery. So, each node is strictly power constrained one. As long as the power is there, each node will be involved in all the three functions of sensing, processing and transmission.

If any node depletes its energy, it will become an unattended node and there may be network partition or no transmission of data from that particular node.

The wireless sensor node save energy network's lifetime depends mainly on the energy in each node. Communication in wireless sensor network such as network communication can be divided in to several layers among that one is MAC layer(Medium Access Control). In general there are hundreds of MAC protocols that are proposed and designed so far to get high energy efficiency and to provide less delay latency so this mac

protocol plays a important role for conserving energy in sensor nodes and ensuring that WSN communicate efficiently.

Traditional MAC protocols are designed to maximize the throughput, minimize the latency and minimize energy consumption.

In this paper, we have reduced both energy consumption and end to end delay in the network by using intelligent hybrid MAC protocol.

II. RELATED WORKS

In wireless sensor network, the authors of [7] obtain one of the new works in contention based MAC protocol. S-MAC is the one type of protocol in which the operate in low duty cycle and energy efficiency is achieved by periodic scheduling. The author [8] improves the energy efficiency of S-MAC by adaptive duty cycle. The T-MAC is another type of Mac protocol which is used to reduce the idle listening by transmitting all message in burst of variable length and sleeping between bursts and maintain an optimal active time under variable load by determining the length. The authors of [3] consider the number of packets being sent at every node and provide an algorithm to obtain the shortest schedules by eliminating the nodes without packets to send at each loop, these algorithm require global topology information, which may be difficult for large size networks. Interference-free TDMA schedules are calculated in for a small-scale network by joint optimization of the physical, MAC, and network layers. The authors use convex optimization to solve the cross-layer-based network lifetime optimization problem, employing the interior point methods.

III.EXISTING METHOD

The existing works on sleep scheduling in WSNs mainly focus on two targets namely,

- Point Coverage
- Node Coverage

3.1 Point Coverage

Existing point coverage oriented algorithms differ in their sleep scheduling goals: minimizing energy consumption or minimizing average event detection latency.

3.2 Node Coverage

This is also called as network coverage, awake nodes are selected to construct a globally connected network such that each asleep node is an immediate neighbour of at least one awake node[8].

3.3 Drawbacks of Existing Method

Local minimum problem arise due to nodes present nearby sink.

1) Sink mobile information is flooded only on demand
2) Each node should not have enough initial neighbours in order to make it easier for the node neighbour node requirement.

IV. PROBLEM DEFINITION

- Sensed data have to reach the Base Station (BS) within a specific time period or before the expiration of a deadline.

- Hence, intermediate nodes require changing the delivery order of data packets in their ready queue based on their importance and delivery deadline.
- Sleep mode problem exists with interference.
- Furthermore, most existing packet scheduling algorithms of WSN are neither dynamic nor suitable for large scale applications.

V. PROPOSED METHOD

The concept of both link scheduling and broadcast scheduling are combined, which is introduced by IH-MAC (Intelligent Hybrid Medium Access Control) protocol[1]. HMAC has implemented that all the node can sleep and awake at same time and same interval, if it does not have any data. In case, any node have the data to send to base station then sender and receiver should be in active mode, remaining all the node is at sleep. To make synchronization between sender and receiver and neighbour node, RTS/CTS. In this project, total time is divided into slots, and further slots into sub-slots. Each node have synchronized timer and each nodes knows when the time slot begins and ends. All the nodes will be in idle listen mode at beginning of each time slot. If any nodes have data then the node will check the slot availability in sub-slot. If nodes have high priority data then it can occupy first sub-slot, or own slot means second sub-slot or else third sub-slot. This project uses the basic CSMA/CA protocol with some modifications. Using this CSMA/CA protocol we can void the interference that occur in the system so this make the network to be very fast transmission. The advanced IHMAC protocol are used.

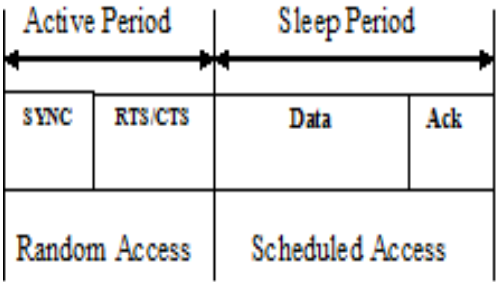

Fig. 1. Slot for IHMAC protocol

VI. STATE DIAGRAM

The state diagram for IHMAC is shown in figure 2 in which during sleep state the node turn off it radios and start a timer with duration which is predefined according to the duty cycle of the protocol with prolongation of rendezvous communication between pair of nodes.

When this predefined timer expires the node goes to wake-up state. It turns on its radio and switch to listen to data channel and goes to idle listening state. Next when it need data to send or receive it go to CSMA/CA state or else it go to sleep state again. When the sender node pass the contention both the sender and receiver go to TX/RX state and go to sleep state after transmitting the data to the intended receiver.

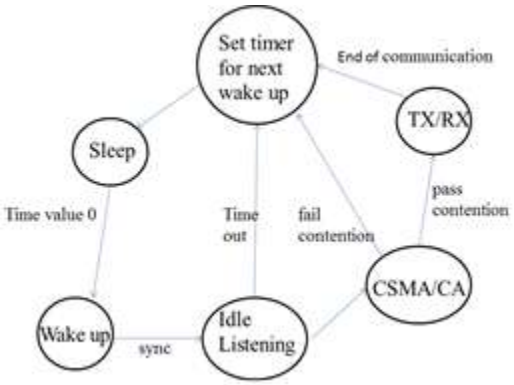

Fig. 2.State diagram for IHMAC

In this project, we are considering a three node A,B,C.[6] for example when a node A need to send the data to node C it need to transfer data by means of the intermediate node B when it does to lie within the radio range or coverage area so in that case A can be in idle listening mode and node B can be in active mode and node c can be sleep mode where rest of the node in the network can also be in sleep modes which is not involved for communication. When the node A transmit data to node B it can go to sleep mode where node B can be in idle listening mode and node C can be in active mode this process continuous for n numbers of nodes. So these all things can be done with the help of RTS/CTS/DATA/ACK signals.

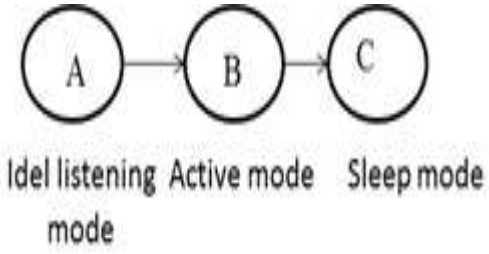

Fig. 3. Node configuration

By transferring data in this type can save more energy because alternate node can go to sleep in each time slot after transferring the data to the intended destination. When the node in idle state it consume only 0.005% of energy while the node is in sleep mode it can consume 100% of energy[7]. so it is better to make the node to be in sleep state to minimize energy consumption for reducing the end to end delay alternate example are considered such as for example consider six nodes in this case (A,B,C,D,E,F). In this case we need to transfer data from node A to node F.

When we need to transfer data from node A to node F but it does not cover the radio range so we have to consider the intermediate node for transferring the data. So in this case we have consider node A,B and C in which node A can be in idle listening state while all the other two nodes can be in active state in which node A will send a RTS/CTS signal to both node B and node C so in this case the will be only minimum delay when transferring the data then node A and node B can go to sleep state. Similarly when considering the next set of node in which node C,D and E in which node C can be in idle state and node D and E can be in active state after transmission node C and D can go to sleep this process continuous until it reach to node F i.e., destination

VII. SIMULATION RESULTS

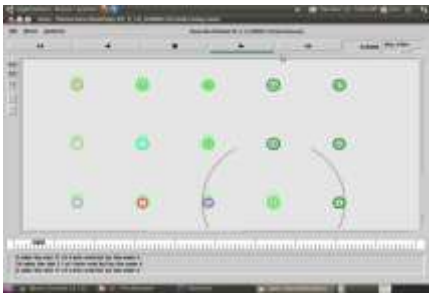

Fig. 4. When all nodes are in active state (green)

In the Fig. 4 we can see that all the nodes are in active state so at this case we can analyse that there is large amount of energy consumption at this situation.

In the Fig. 5 we can tell that grey coloured node indicate that the node is idle state next the yellow colour in the figure indicate that the node is waiting for a packet to its radio coverage finally the green colour indicate the node is in active state that is it will accept the packet from the neighbouring node.

Fig.5.Colour description of each node.

- Grey- idle state
- Yellow- frequency match (waiting for packet)
- Green- active state

Fig.6. In this node 12 sender and node 13 receiver.

In the Fig. 6, we can tell that node 12 and node 13 is a sender and receiver in which the node 12 will send the data to node 13 in this case the two nodes communicate with each other by means of RTS/CTS signal.

Fig. 7. Node 12 Ready to Send Data to Node 13.

In the Fig. 7 the node 12 is ready to send the data to node 13 so it see for the frequency match within the radio coverage if it match then it will attain in yellow colour.

In the Fig. 8 is the final simulation result when they complete the transmission of packet from one node to another at this case we had assumed that going to transmit data from node 12 to node 13at this time when it transmit data from node 12 to 13then node 12 will attain idle state and node 13 will be in active state so this will continue until the end of the transmission

Fig. 8.Node 13 Will Receive Data Node 12 Will Go To Idle State.

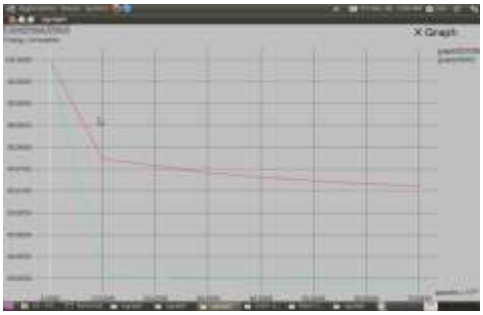

Fig. 9. Comparison Of Energy Level.

The Fig. 9 indicates the energy level of both existing and proposed when comparing to the existing method the proposed method will consume only less energy since it change from active state to sleep state.

Fig. 10. When The Node is in Active State.

Fig. 10. indicates that when all the node are in active eat this state we can notice that it will consume large amount of energy.

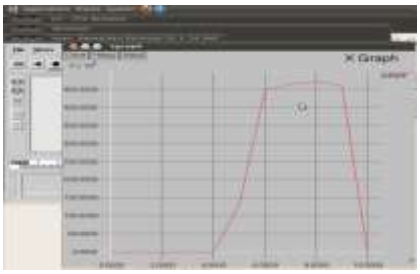

Fig. 11. When the node is in sleep mode.

In the Fig. 11, when some of nodes is made to sleep mode at this stage we can see that it will consume less amount of energy so in idle state each node will consume only 0.005% of energy. So from the above diagrams we can analyze that when all the nodes are in active state it will consume more energy so this IHMAC protocol used so some of the nodes in active state and some in sleep mode in turn can consume only less amount of energy this observation can be done with the help of NS2 software.

VIII. CONCLUSION

The Intelligent Hybrid MAC (IHMAC) protocol are used to reduce the per bit energy consumption and end to end delay in the network this work can be done with the help of NS2 simulation tool. The existing GCKNA algorithm in which each node should not have enough initial neighbours in order to make it easier for the node neighbour node requirement. so this type of problem will not occur in IHMAC.

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