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Enhancement algorithm for Wireless Sensor Networks in S-MAC Protocol

Monika[1], Sunil Kumar[2] (Assistant Professor)
[1]M. Tech Scholar, Computer Science & Engineering, RPSGOI Mohindergarh, India
[2]*Computer Science & Engineering, Maharashi Dayanand University, Rohtak, India*

***Abstract*– Wireless sensor networks have emerged as an important new area in wireless technology for twenty first century. It is used in environment monitoring, agriculture and many hazardous places Wireless sensor network use battery operated computation and sensing devices. The nodes sensing all the time and transfer the sensing information to the base station and drop down battery power quickly. So the main problem is to minimize the energy consumption and make the life of wireless sensor longer. The S-MAC protocol is the solution. S-MAC protocol uses three technologies to minimize energy consumption and support self- configuration.**

The first, neighbouring nodes are synchronized to go to sleep periodically. Second, the synchronized neighbouring nodes make a virtual cluster to synchronise their wake-up and sleep periods so the control packet overhead is kept low. Third message passing is used to reduce contention latency and control overhead.

***Keywords*-- S-MAC, Wireless sensor network, Energy consumption, Latency.**

I. INTRODUCTION OF WSN

Wireless sensor networks that have emerged as an important new area in wireless technology for twenty first century. A wireless sensor networks are used to *monitor* physical conditions, such as heat, wave, pressure, etc. and to cooperatively pass their sensed data and information through the network to a main location. WSN use battery operated computing and sensing devices.

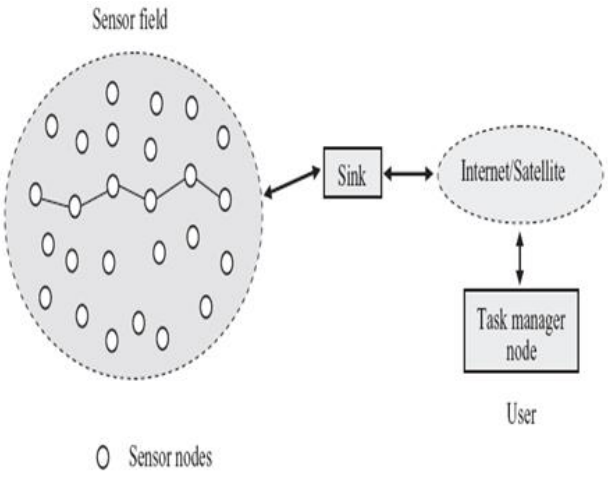

Fig: Diagram of WSN with sensor field and node

The nodes sensing all the time and transfer the sensing information to the base station and drop down battery power quickly [1] .So less energy consumption of the sensor to increase the lifetime of whole network is main concern while designing any protocol for WSN. In order to increase the life time of network, we can control the radio of sensor node. Sensors use power for some computation, e.g. sending control message and sensing. But other than this consumption most energy waste is happen due to four causes like collision, overhearing, ideal listing and control packet overhead. Sensor –MAC is MAC layer protocol specially designed for wireless sensor network [2]. MAC is a key component to ensure the successful operation of WSNs and A MAC protocol decides when competing nodes could access the shared medium and tries to ensure that no collisions occur while nodes' transmission.MAC has many protocols like CSMA/CD,TDMA,S-MAC etc. [3], [4].We studies here the s-mac protocol.

S-MAC protocol used sleep scheduling algorithm that consists of listen and sleep period. There are no clusters or cluster heads in the network and the network topology is flat [5]. Sensor - MAC focuses mainly on energy conservation in major energy wastage sources, while achieving good scalability and collision avoidance capability.

1.1 The Main Factors That Cause Energy Consumption

To design an energy-efficient MAC protocol, some factors should be analysed that lead to energy consumption [9]. Through a great deal of experiments and theoretical analysis, some factors that cause the energy consumption of sensor nodes described as follows:

. Idle listening

As the node doesn't know when the neighbouring nodes send data to it. RF module has to be in the receiving state so as to receive the packets transmitted to it. This kind of listening can waste a great of power, especially in WSN with low rate of data.

· Collision

In the situation of sharing the wireless channel in competitive mode, when two packets are transmitted at the same time, there will be collision, then the packets have to be retransmitted subsequently. As we know, transmitting data needs energy.

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· *Overhearing*

When a node receives a packet that transmitted to other node, the node will deal with these unnecessary data, which will make the wireless receiving module and processing module consume more energy.

A MAC protocol should avoid and reduce the energy consumption caused by the factors mentioned above.

1.2 Sensor medium access control protocol (S-MAC)

S-MAC (Sensor Medium Access Protocol), a clustering-based protocol that minimizes energy dissipation in sensor networks. The key features of S-MAC are:

To conserve energy by avoiding overhearing in idle listening.

To avoid collisions and to address the hidden terminal

To fragment long packets into several frames and send them in burst.[6]

SMAC introduces a sleep scheduling algorithm that sensor nodes sleep for most of the time and wake up only to send data and to synchronize with networks. Thus, one S-MAC cycle time is divided into a sleeping period and a wakeup period. The wakeup period consists of SYNC period, RTS/CTS period, and data transmission period. In every SYNC period, sensor nodes broadcast a SYNC packet to neighbour nodes. Nodes also use the receiving SYNC packets to synchronize with neighbour nodes in the network. The SYNC packet contains sender's next sleeping time which tells receiving nodes when the next transmission would take place for the next cycle. The RTS/CTS period is used to request for transmission and to response with a permission to transmit. Then, sensor nodes can send or receive data. The sleep schedule starts when sensor nodes are deployed to the workspace. Then every node keeps listening to the channel for a random time period from their neighbouring nodes for a SYNC packet. If a sensor node does not receive any SYNC packet at the end of the period, it will generate a sleep schedule, and then broadcast the schedule within a SYNC packet [10].

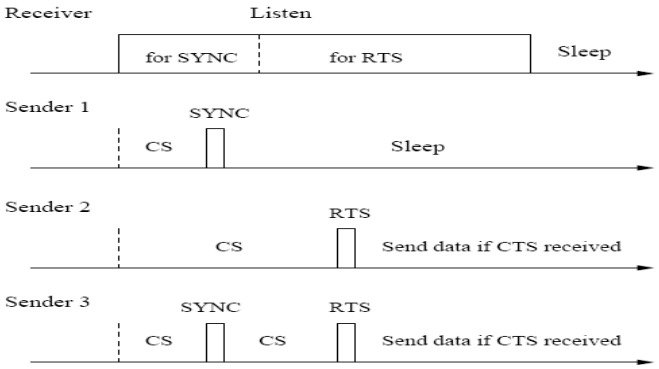
Sensor nodes receiving a SYNC packet during the listening period will use the sleep schedule attached in the SYNC packet.

The sleep schedule in S-MAC can reduce the network energy consumption by introducing a low duty cycle for each node. By using the sleep schedule, S-MAC can trade off the latency with the energy saving.[7]

1.2.1. Periodic Listen and Sleep:

SMAC adopts the mechanism which allows nodes periodically go to sleep after a certain time of listening.

Each node goes to sleep for some time and then begins to listen to the channel by a timer awaking it later. During sleep, the node turns off its radio, in this way, nodes can conserve some energy.



3. Timing relationship between a receiver and different senders. CS stands for carrier sense.

Fig 2: periodic listen and sleep

In SMAC, each node maintains a schedule table that stores the schedules of all its known neighbours. The course of establishing the schedule table is as follows:

After a node starts working, it will listen for a fixed Schedule of time. By that time, if it doesn't hear a schedule from its neighbours, it will choose its own schedule and start to follow it. Immediately after that, the node broadcasts a SYNC packet to announce the schedule.

If during that fixed of time the node receives a schedule from a neighbouring node, it will set its schedule to be the same.

II. Performance Evaluation

To evaluate the performance of the proposed protocol, we use the ns2.29 simulator tool [8]. To measure the energy consumption on the radio, we measured the amount energy consumption of each node through the trace graph, goals after executing the simulation as per the scenario

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Table 1.
Simulation Parameters

Parameters	Value
Number of nodes	16
Topography Dimension	670 m x 670 m
Interface Queue type	Drop Tail/Pri Queue
Signal Propagation Model	Two ray ground
MAC Type	802.11 MAC Layer
Packet size	512 bytes
Mobility Model	Random Way Point
Antenna Type	Omni Directional
Mobile Routing Protocol	AODV
Channel	Wireless Channel
Link Layer Type	LL
Network Interface Type	Wireless Phy

Graph given below, shows the results of energy consumption with respect to simulation time.

It is shown in graph at simulation time 1.0 mille seconds; energy consumption is approximately 150 joules. As time passes energy consumption is decreased, at time 2.5 mille seconds, energy consumption is 117 joules. There is decrement in energy consumption and increment simulation time. Similarly at simulation time 4.0 mille seconds, energy consumption is 92 joules. After 5 mille seconds, energy consumption is 21 joules. Finally at simulation time 10 mille seconds and energy consumption is 20 joules. At last we can say that if simulation time is increased then energy consumption is decreased. Initially there was 150 joules of energy and at last we have 20 joules.

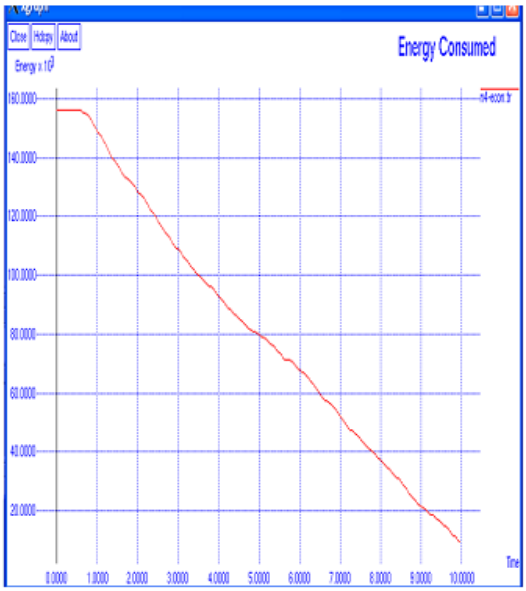

Figure 3.Energy Consumption Vs. Simulation Time

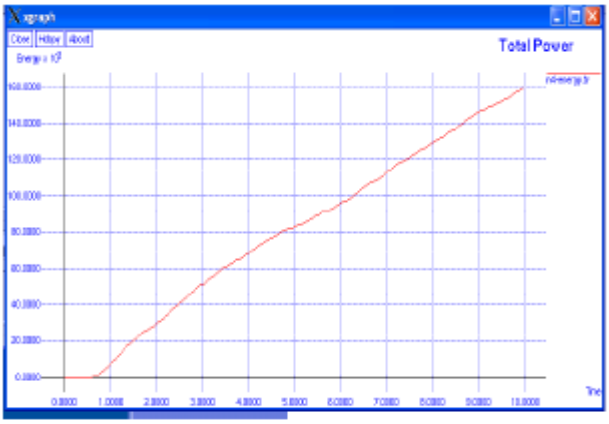

Fig 4: Total Energy Vs. Simulation Time

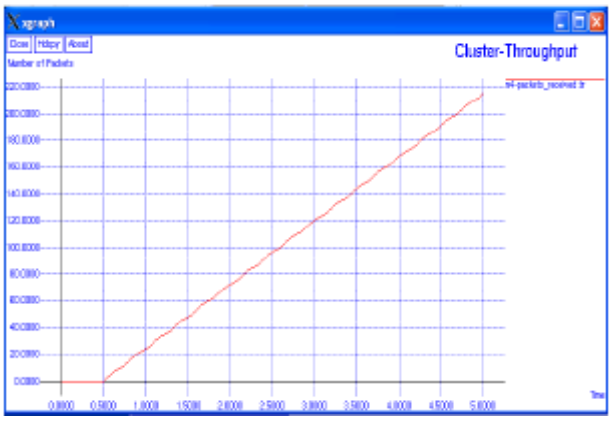

Fig 5: Number of Packets Vs. Simulation Time

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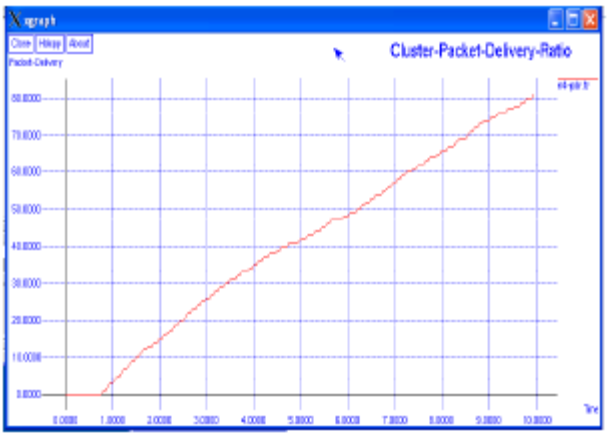

Fig 6: Packet Delivery Vs. Simulation Time

III. Conclusion

In this work energy consumption, total power, cluster throughput, and packet delivery ration is implemented.

It is proved that energy consumption is reduced and also increase the lifetime of the WSN. It also increases the total power and packet data ratio. It is shown that the S-MAC protocol using sleep scheduling algorithm offers a better solution to energy efficiency usage in a WSN as compared to other technique.

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