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EXTENDING THE LIFE TIME OF WIRELESS SENSOR NETWORK USING ADAPTIVE PROTOCOLS

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***Abstract*—In the present scenario wireless sensor network plays a vital role for many applications. But energy consumption is an important constraint in this technology. In general for extending the network life time the activity of the transceiver should be reduced as it consumes more power. In this work an Adaptive staggered sleep protocol (ASLEEP) for efficient power management is proposed in order to match the network demand. This protocol dynamically adjusts the sleep schedules of nodes in time varying conditions, without any prior knowledge of the network topology. This protocol has been extensively studied and it has been observed that the energy consumed by the sensor nodes will be reduced. Under stationary conditions this will increase significantly the network life. The delivery ratio has also been increased with respect to non-adaptive solutions. The results presented here have been carried out with the help of ns-2 simulation.**

***Index Terms*— Energy conservation, performance evaluation, power management (PM), sleep/wakeup scheduling.**

I. INTRODUCTION

The sensor network is a collection of small-size, low power, low-cost sensor nodes that have some computation, Communication, storage and even movement capabilities. These nodes can operate unattended, sensing the environment, generating data, processing data and providing the data to users. With these features, sensor networks have been adopted in many pervasive computation and communication scenarios such as remote surveillance, habitat monitoring, and so on.

To design a good MAC protocol for the wireless sensor networks, the following attributes need to be considered. The first is the energy efficiency. As stated above, sensor nodes are likely to be battery powered [1] and it is often very difficult to change or recharge batteries for these nodes. In fact, someday it is expected some nodes to be cheap enough that they are discarded rather than recharged. Prolonging network lifetime for these nodes is a critical issue.

Another important attribute is scalability and adaptively to changes in network size, node density and topology. Some nodes may die over time; some new nodes may join later; some nodes may move to different locations. A good MAC protocol should gracefully accommodate such network changes. Other typically important attributes including fairness, latency and throughput and bandwidth utilization may be secondary in sensor networks.

The most important concern of designing such networks is efficient energy consumption [2], which leads to longer Lifetime of the networks. To reduce energy consumption and prolong network lifetime, sensor networks are usually duty-cycled. Each node remains in low-power sleep mode most of the time, and wakes up periodically to sense for channel activities. The Medium Access Control (MAC) layer is responsible for arbitrating access to the shared medium in a fair and efficient manner. By incorporating wakeup schedules into MAC operations, nodes need not monitor the channel continuously for communication.

II. SYSTEM MODEL

The sleep/wakeup schemes can be classified into three main categories: on demand, asynchronous and scheduled rendezvous. On-demand schemes assume that destination nodes can be awakened somehow just before receiving data [3]. Two different radios are typically used. The first data radio is used during the regular data exchange, while the second one wakeup radio is a very low power radio which is used to awake a target node when needed. These schemes can achieve very high energy efficiency and a very low latency. However, they cannot be always used in practice because commonly available sensor platforms only have one radio. In addition, the wakeup radio has typically a transmission range significantly shorter than the data radio. A different option is using an asynchronous scheme. In this case, nodes can just wakeup whenever it wants and it can still communicate with its neighbours. Although being robust and easy to implement, asynchronous schemes generally present high latency in message forwarding and have issues with broadcast traffic. The last category of independent sleep/wakeup schemes is represented by scheduled rendezvous schemes, which require

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that nodes are synchronized and neighbouring nodes wake up at the same time. Our ASLEEP protocol belongs to this last category.

Medium Access Control (MAC) protocols determine which node can access the channel, and also when the node can put its data into the channel. MAC protocols have a great influence on the WSN performance. The most essential feature that a good MAC protocol for the wireless sensor networks should possess is the energy efficiency. Idle listening is the major concern for energy consumption. By using wireless LAN (802.11) mac protocol in wireless sensor network, each node having long listen period .If nothing is sensed during the listen period , nodes are in idle mode for most of the time.

To avoid this idle listening, adaptive sleep mechanism [4] is introduced in the MAC protocol. It lets the node to sleep period while the medium is busy and don't have data packet to transmit and receive.

III. Adaptive Staggered Sleep Mechanism

Duty cycling is the better scheme to reduce power consumption. Duty cycling is nothing but during idle times it switches off the subsystem.

Two power management protocols are used to achieve duty cycling effectively.

1. Mac protocol
2. Independent sleep/wake up protocol

Comparing to this two schemes mac protocol having some dis advantages likely can be used to a particular sensor platforms only. Flexibility also low in mac protocol [5]. Comparing to mac protocol, independent sleep/wake up protocol having higher flexibility and it is not tied to particular mac so it can be used with different sensor platforms. Asleep protocol belongs to independent sleep/wake up scheme.

ASLEEP protocol mainly used for data collection (monitoring) applications. This scheme automatically [6] adjusts the activity of sensor nodes to achieve low power consumption. This scheme introduces a mobile sink node. Within its range of sensing capability senses the nodes, collect the global information and periodically report to a sink node. This mobile sink node is having the capability of moving in the whole network in random manner. By using this mechanism ASLEEP protocol minimize the active periods of sensor nodes in order to reduce power consumption. The nodes monitored by mobile sink node only use energy. This scheme also increases the pocket delivery ratio. The active times of sensor nodes are staggered according to their position along the sink node. Nodes located at different levels are wake up at different progressive times to reduce the usage of power.

ASLEEP technique is used by flexible power scheduling, which includes an on – demand reservation mechanism able to dynamically adapt to traffic demands.

It also includes mechanism for increasing the probability of successful delivery of direct beacons and enforcing a correct behavior of nodes in case they miss a direct beacon.

ASLEEP protocol can work correctly and efficiently even when the wireless communication is unreliable. Its robustness against communication errors could be further enhanced by means of traditional techniques for increasing wireless reliability.

IV. Simulation Results

Network simulator-2 is used to compare the performance among the proposed asleep protocol with existing mac protocol through simulation [7].

For performance comparison, the simulations are done using ns-2.34.figure 1 shows the network architecture used for simulation.

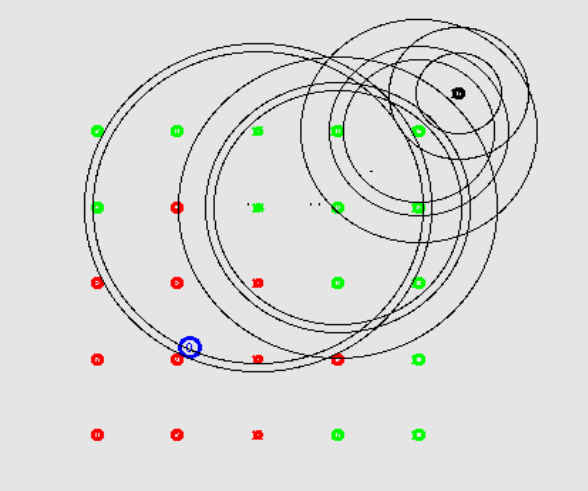

Figure 1 simulation configuration

This network consists of 26 nodes. 0th node represents mobile node used for data monitoring application. This node sense and collect the global information from a group of nodes and send it to sink node. The nodes which are present inside the sensing range only consume energy. The remaining nodes are set in to sleep position.

A. Results and analysis

The simulation has been done to compare the energy consumption, packet delivery ratio, goodput between asleep with existing WLAN mac protocol.

Figure 2 represents the comparisons of number of nodes vs energy consumed. By using both mac protocol and asleep protocol the energy is calculated for increasing the number of nodes. Comparing this two asleep consumes less energy than mac protocol.

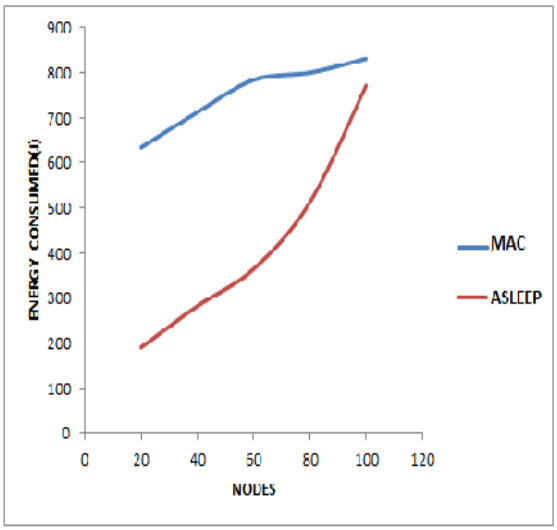

Figure 2. comparison of nodes vs energy consumption

Figure 3 explains the usage of energy for different rate (pack/sec).when the packet rate is increased means network traffic also increases this increases the amount of power consumption.by applying ASLEEP protocol scheme effectively reduces the usage of power .this case also proposed protocol uses less energy than existing protocol.

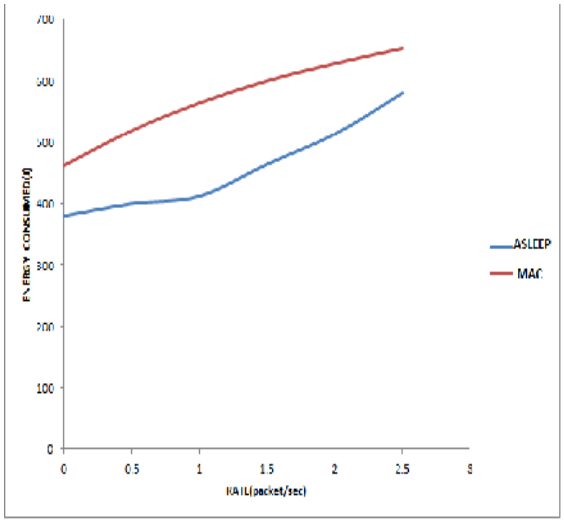

Figure3 comparison of Rate vs energy consumption

Good put is nothing but the amount of useful information received per second. figure 4 shows ASLEEP protocol receives better goodput values than wireless MAC by using an adaptive sleep mechanism.

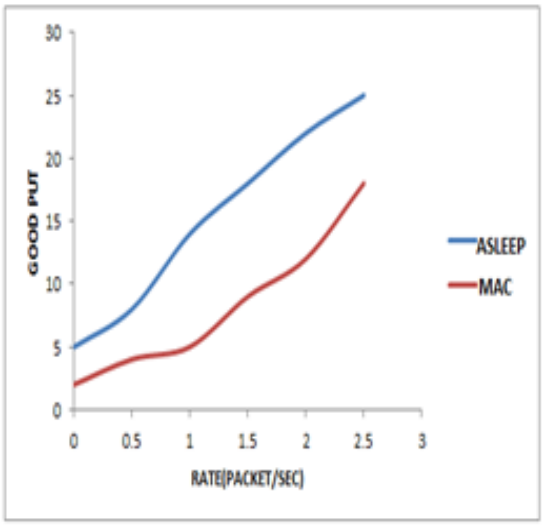

Figure 4. comparison of Rate vs good put

Figure 5 shows good put values for increasing the number of nodes. The number of node increases means the delay also increases .This increased delay reduces the good put. While using ASLEEP protocol the delay is effectively reduced. So good put value is increased

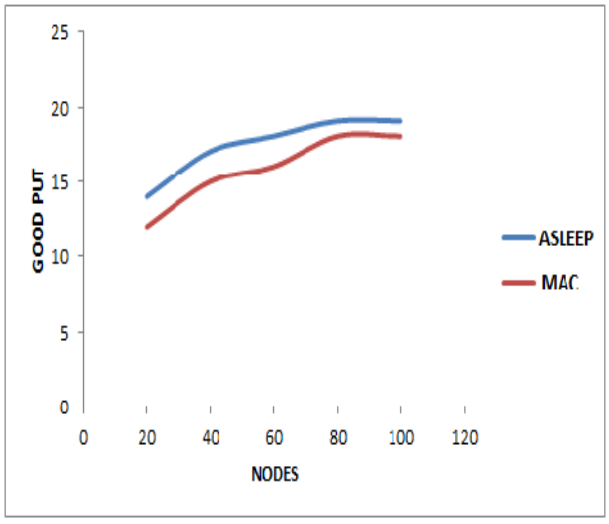

Figure 5. comparison of Nodes vs Goodput

Packet delivery ratio is nothing but the ratio of received packets to the number of packets send. The percentage of pdr value is good for ASLEEP comparing existing protocol.

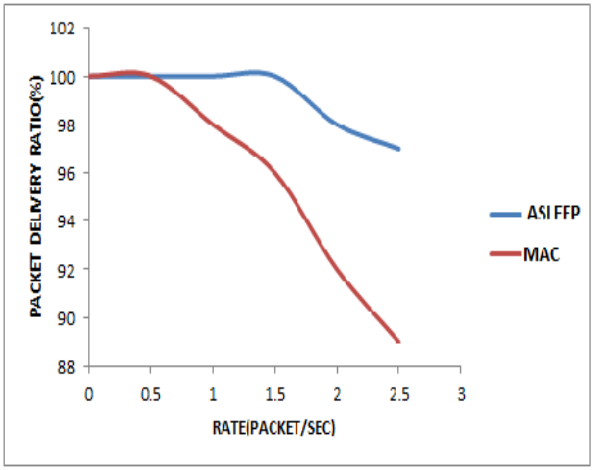

Fig 6. Comparison of Rate vs. Pdr

V. CONCLUSION

In the existing protocol scenario the nodes are consuming more energy by continuously monitoring the environment. This will lead to reduce the life time of the nodes and the sensor network. In Adaptive staggered sleep method, the nodes which are coming under the surveillance of the mobile node only do the sensing operation and it will generate data to transmit to mobile node. This will reduce the energy consumed by each node in the network. So while using ASLEEP protocol, the life time of the wireless sensor network is improved.

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