AN APPROACH TO IMPROVE PERFORMANCE OF MAC IN WSN BY REDUCING LATENCY

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Abstract- The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. MAC layer is concern with the sharing physical connection to the network among several computers. It is responsible for moving data packets to and from one Network Interface Card (NIC) to another across shared channel. The main purpose of MAC is to provide addressing, framing, and perhaps error detection for the type of the media that will be used. MAC protocols are used in MAC sub layer. There are two different types of MAC protocols: the fixed assignment channel access methods which assign nodes onto different time slots to avoid collision (TDMA), and the contention-based channel access methods in which nodes compete for the wireless communication channel, an example such as carrier sense multiple access (CSMA) but in our work we use energy parameters before sent data based on the energy value, data rate and location information each node participate in communication. Using this approach we can improve energy consumption delay and throughput of network.

Index Terms – energy efficiency, low duty cycle, MAC protocols, wireless sensor networks.

I.   INTRODUCTION

Wireless Sensor Networks (WSNs) is a many-to-one network, where all sensor nodes cooperate to collect and forward data to one or few nodes called sinks. WSNs have been deployed for multifarious applications like agriculture field monitoring, radioactive leakage detection, emergency medical care, military applications etc [1][2]. As WSNs are used in different environment there are many objects move frequently and connection between sensors nodes are interrupted due to movement of objects. Current WSNs are deployed on land, underground, and underwater. Depending on the environment, a sensor network faces different challenges and constraints. There are five types of WSNs: Terrestrial WSN, Underground WSN, Underwater WSN, Multi-media WSN and Mobile WSN.

The center of interest is improved collision free and energy efficient Wireless sensor network. Wireless sensor network having many issues like limited battery power, collision of data packets, interference, loss of signal strength and many more. Here we introduce new MAC (Media/Medium Access Control) protocol for solving the different issues of WSNs Lots of techniques for energy efficient and collisions free have been recommended. Various techniques have been outlined in this thesis report. Rapidly increase the use of wireless sensor networks in many applications, promising the optimal use of battery power is challenging task. The performance of different MAC protocols have been studied and compared. There are number of issues need to be resolve with better performance of existing techniques. Main motivation of our proposed work is to improve characteristics like natural energy saving mechanism and collision free MAC protocol.

Data Link Layer the second layer of OSI model contains two sub layers Logical Link Control (LLC) and Media Access Control (MAC). Three main function of Data Link Layer are handling of transmission errors, regulates flow of data and interface to the network layer [6]. MAC layer is concern with the sharing physical connection to the network among several computers. It is responsible for moving data packets to and from one Network Interface Card (NIC) to another across shared channel [8]. The main purpose of MAC is to provide addressing, framing, and perhaps error detection for the type of the media that will be used. MAC protocols are used in MAC sub layer.

A. Contention Based Protocol

In contention based MAC protocol there is not a priori resource reservation, whenever a packet should be transmitted the node contends with its neighbor for access to the shared channel and these types of protocols are not providing quality of services guarantees. Sender Initiated Protocols Packet transmissions are initiated by sender node. In single channel sender initiated protocols total bandwidth is used where in multichannel sender initiated bandwidth is divided into multiple channels. Receiver Initiated Protocols Packet transmissions are initiated by receiver node.

B. Contention Based Protocol with Reservation Mechanism

In this type of protocols bandwidth are primarily reserved and it supports real time traffic through quality of services (QoS) guarantees.

C. Synchronous Protocols

Time synchronization among all nodes in the network are required. Global time synchronization is difficult to achieve in large networks.

D. Asynchronous Protocols

In these protocols do not require any global time synchronization it is usually rely on relative time information for effecting reservation.

E. Contention Based Protocol with Scheduling Mechanism

In these protocols main focus on the packet scheduling at nodes and also scheduling nodes for getting access to channel. Sometimes battery characteristics, such as remaining battery power are considered while scheduling nodes for access to the channel.

II. RELATED WORK

This section contains some theoretical background of Medium Access Control (MAC) protocol in Wireless Sensor Networks. This section describes how different MAC protocols are works in different environment.

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Wireless Sensor Network (WSNs) are appealing to researchers due to wide range of application potential such as target tracking system, traffic monitoring, environmental monitoring etc. Various Media Access Protocol (MAC) are proposed with different objectives have been proposed for wireless sensor networks. Here, we describe several MAC protocols proposed for sensor networks, emphasizing their strength and weakness.

S-MAC (Sensor-MAC)

Locally managed synchronizations and periodic sleep–listen schedules based on these synchronizations form the basic idea behind the Sensor- MAC (S-MAC) protocol. Neighboring nodes form virtual clusters so as to set up a common sleep schedule. If two neighboring nodes reside in two different virtual clusters, they wake up at the listen periods of both clusters. A drawback of the S-MAC algorithm is this possibility of following two different schedules, which results in more energy consumption via idle listening and overhearing.
Schedule exchanges are accomplished by periodic SYNC packet broadcasts to immediate neighbors. The period for each node to send a SYNC packet is called the *synchronization period.* Collision avoidance is achieved by a carrier. Furthermore, RTS/CTS packet exchanges are used for unicast-type data packets.

TRAMA (Traffic Adaptive Medium Access Protocol)

TRAMA is a TDMA-based algorithm proposed to increase the utilization of classical TDMA in an energy-efficient manner. It is similar to Node Activation Multiple Access (NAMA), in which for each time slot a distributed election algorithm is used to select one transmitter within each two-hop neighborhood. This kind of election eliminates the hidden-terminal problem and hence ensures that all nodes in the onehop neighborhood of the transmitter will receive data without any collision.
Time is divided into random-access and scheduled-access (transmission) periods. The random-access period is used to establish twohop topology information and the channel access is contention-based within that period. A basic assumption is that, with the information passed by the application layer, the MAC layer can calculate the transmission duration needed, which is denoted as *SCHEDULE_INTERVAL.*

DMAC

The principal aim of DMAC is to achieve very low latency for converge cast communications, but still be energy efficient. DMAC could be summarized as an improved Slotted Aloha algorithm in which slots are assigned to the sets of nodes based on a data gathering tree. During the *receive* period of a node, all of its child nodes have *transmit* periods and contend for the medium. Low latency is achieved by assigning subsequent slots to the nodes that are successive in the data transmission path. DMAC achieves very good latency compared to other sleep/listen period assignment methods. The latency of the network is crucial for certain scenarios, in which DMAC could be a strong candidate. Collision avoidance methods are not utilized; hence, when a number of nodes that have the same schedule (the same level in the tree) try to send to the same node, collisions will occur.

III. PROTOCOL DESIGN

Mod-MAC, the distributed energy and location aware Mod-MAC protocol is based on TDMA and hence possesses the natural ability of avoiding more energy wastage. The main advantages of our work are:

Packet loss due to collisions is absent because two nodes do not transmit in the same slot. Although Packet loss might be occur due to other reasons like interference, loss of signal strength etc. No contention mechanism is required for a node to start sensing its packets since the slots are pre-assigned to each node. No extra control overhead packets for contention are required. Mod-MAC uses the concept of periodic listen and sleep. A sensor node switches off its radio and goes into a sleep mode only when it is in its own time slot and does not have anything to transmit. It has to keep the radio awake in the slots assigned to its neighbors in order to receive packets from them even if the node with current slot has nothing to transmit.

The protocol has two types of packets, data packets and control packets.

Data packets: These are normal data packets received from higher layer protocols, which are routed to the base station.

Control packets: The normal packet contains two fields. The first field specifies the type of the packet and the second field specifies the value attributed to the type of the packet. These control packets identify residual energy and time slot for communication.

Initially each node is assigned two TDMA slots for transmission. Each node knows the transmission slots of its neighbors. Nodes periodically exchange information about their energy levels, location and criticality and determine whether to use one or two slots for transmission. Initially the energy-mode of all nodes is set to TRUE to allow nodes to transmit in two slots. Each sensor node can be in any of the following two phases.

Normal operation phase: The nodes operate normally, routing data packets to the sink/base-station.

Critical phase: Critical nodes enter the Critical phase to do a local election and readjust their slots base on energy.

The Critical phase is triggered by criticality of a node. A node becomes critical if its energy falls below a threshold energy value. When The critical node triggers a critical phase then it cannot communicate. A node is normal when energy will be sufficient. Otherwise it declares itself a critical.

The sequence of steps followed by sensor node i triggering the critical phase are as follows:

Node i broadcasts its current energy, current location information and flow rate to all its neighbors through control packets. At the end of one TDMA cycle, node i calculates criticality values of all nodes based on obtained energy and traffic

information. If $C_i < C_j$ for all j, where j is the set of neighbors of i, then it sets energy-mode to TRUE and Send data. Otherwise it sets energy-mode to FALSE and declares itself a critical. At the end of the critical phase node i sends its current value of energy-Mode to all its neighbors.

The sequence of step followed by each receiver node j in the critical phase is as follows:

Node j broadcasts its current energy and flow rates during its transmission slot. If the energy-mode value received from i is TRUE then it adjusts its TDMA frame to accommodate slots for i.

In normal operation mode, the activity of each node in a time slot is the following:

If it owns the current slot then it sends any available data. If it has nothing to transmit, the radio is put to sleep. If it does not own the current slot, it checks its slot table to see whether this is the second slot of the current sender. If so, the slot is idle and it puts its listening radio to sleep. A critical (low energy/high rate) node sleeps longer, thus balancing energy consumption among the nodes and increasing the lifetime of the network. Using this approach we will improve data aggregation and energy.
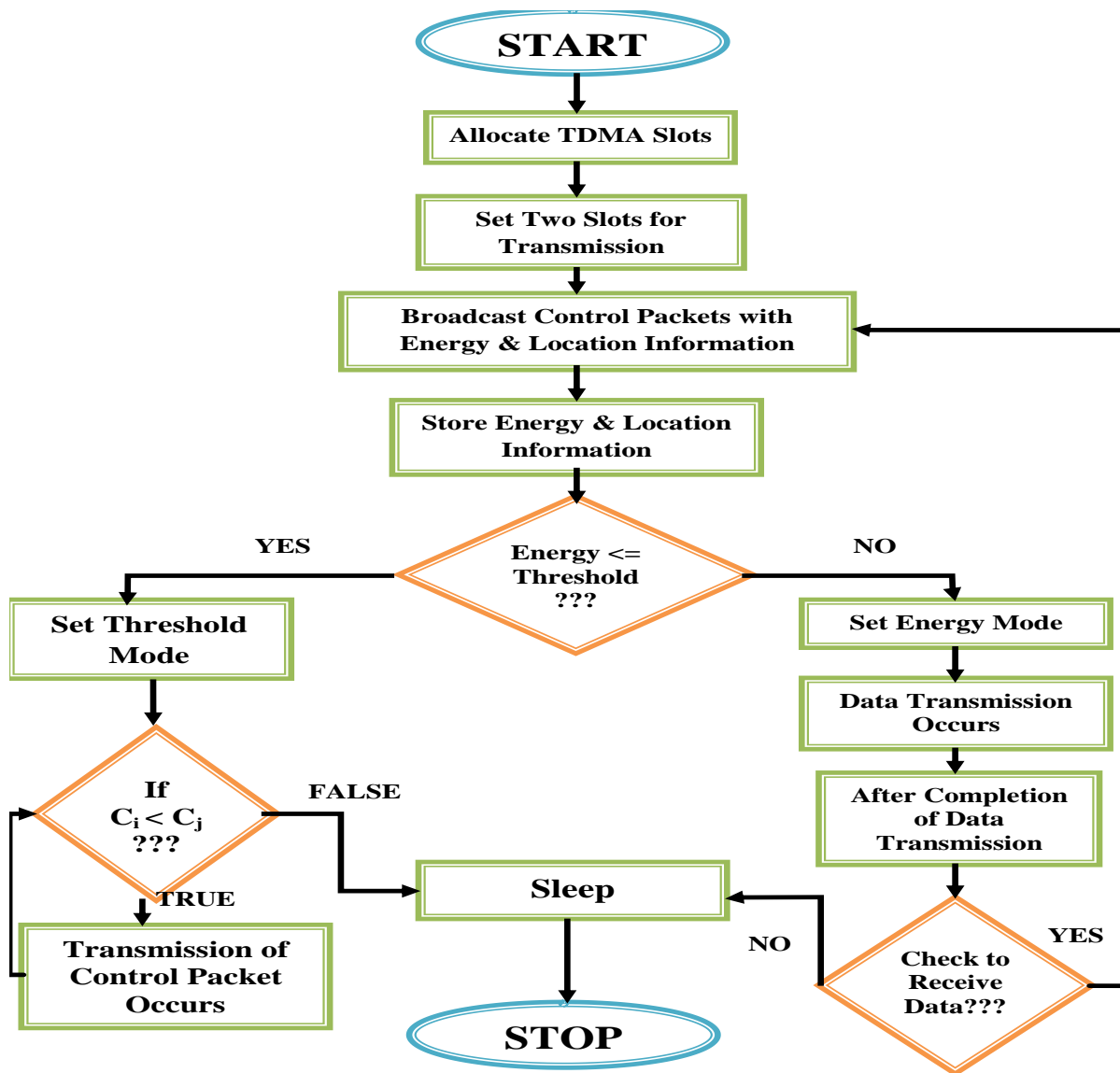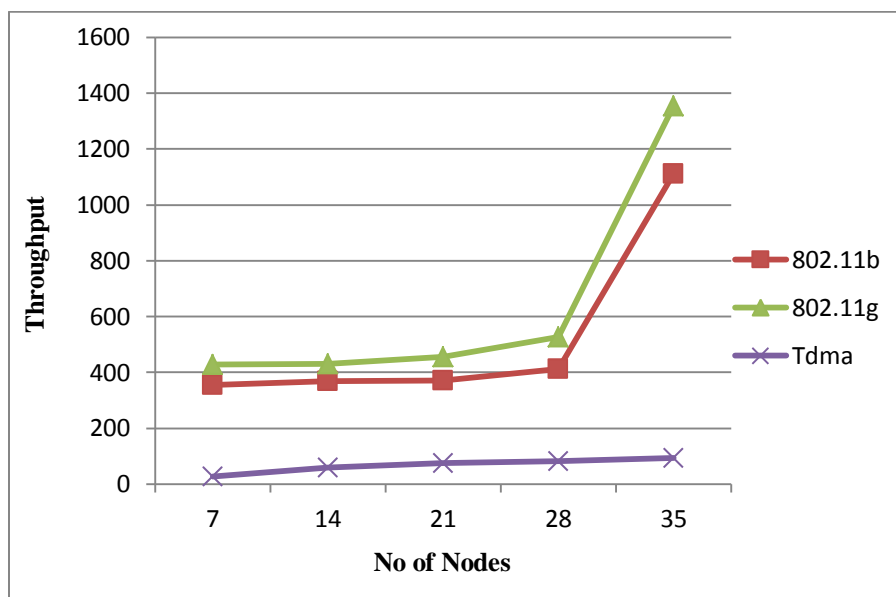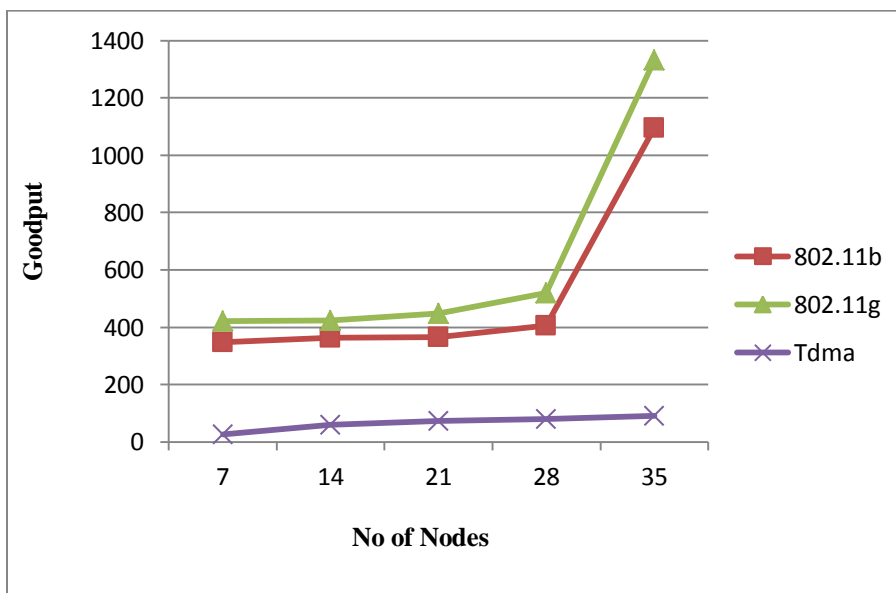

Fig 1: Flow Chart of Modified MAC Protocol

IV. PERFORMANCE EVALUTION

In this section results of existing system and proposed system will be discuss. Here we are comparing our proposed system with the existing system we are comparing different parameters like throughput, goodput.
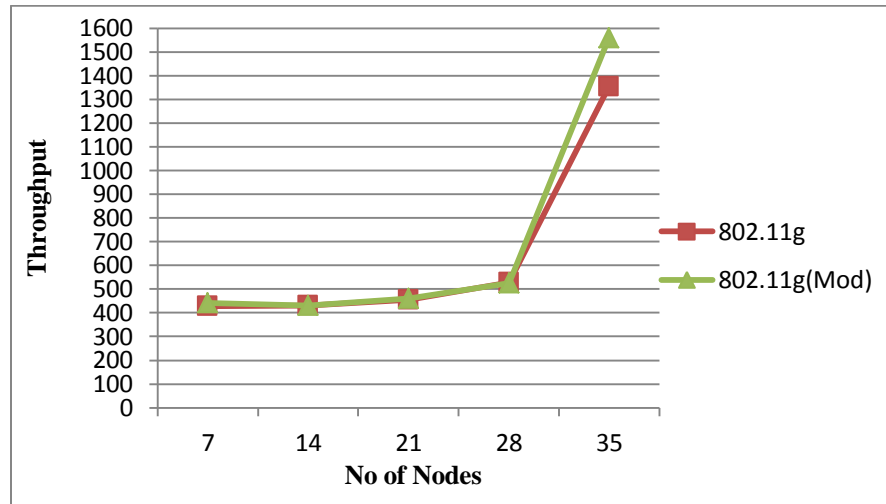
A. 802.11g,b and TDMA

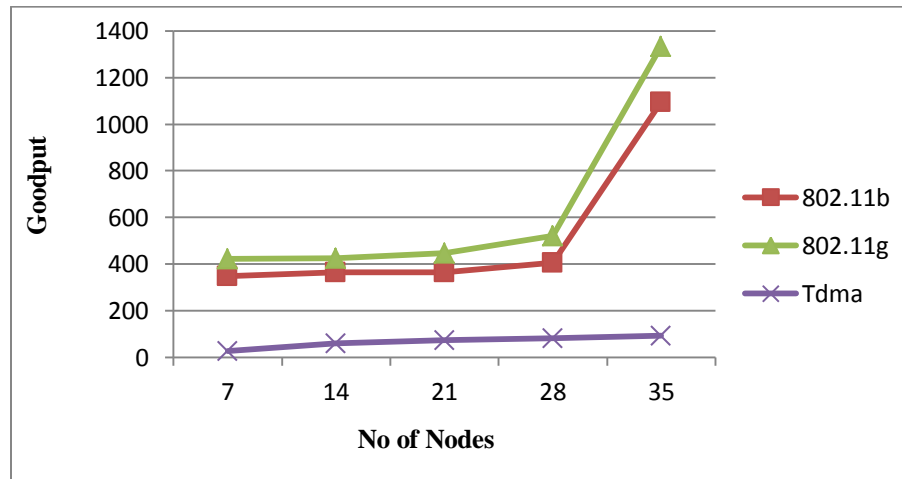*Fig 2: Throughput (802.11b, g & TDMA)*

Fig 3: Goodput (802.11b, g & TDMA)

B. 802.11g and Modified 802.11g

Fig 4: Throughput (802.11g & Modified 802.11g)

Fig 5: Goodput (802.11b, g & TDMA)

V. CONCLUSION

From this work we conclude that media access through sensor node using TDMA technique. In a previous work only modify sleep and awake condition but in our work we use energy parameters before sent data based on the energy value, data rate and location information each node participate in communication. Using this approach we can improve energy consumption delay and throughput of network. Research work presented in this paper myriads of opportunities for providing energy savings and future work comprises design and analysis of relaying protocols for WLAN standards with higher modulations.

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