**ABSTRACT**

Wireless Sensor Network is a spatially distributed autonomous sensor to monitor physical or environmental conditions such as temperature, sound, pressure, humidity, motion, vibration and transmits it to the sink. Every sensor node has a processor, memory, power supply and transducer. Some of the characteristics of wireless sensor networks are self configuring, environmental interaction, scalable for large networks, ease of use, cost variant.

Medium Access Control (MAC) is present in the second layer of the OSI reference model. Medium access control provides channel access to the nodes i.e., it allocates the addressing and the channel accessing control mechanism which enables more number of nodes to communicate over the network. MAC layer has some great responsibilities about the encapsulation of the data and also checks for frame assembly to start the transmission.

Network layer performs the function of routing. The main aim of this networking layer protocol is to establish a reliable path for data transmission. Apart from routing the data aggregation and data fusion is used in this network layer to overcome the redundancy of data packets. The redundancy occurs because of more than one sensor sends the same information to the neighbouring node and this is an unwanted wastage of the energy to the sensors.

In wireless sensor network, the energy is the major constraint. Most of the sensor nodes are made inactive due to its unnecessary energy drain. Usually the sensors suffer high energy consumption due to some of the factors. They are as idle listening to the channel, hidden terminal problem, redundant packet transmission, excessive Overheads and collision of packets.

Optimal Intelligent Hybrid MAC protocolis proposed to reduce the contention of the nodes by assigning grid values to the nodes of the cluster. This protocol follows an adaptive duty cycling schedules to move the sensor nodes to sleep and wake up state so as to reduce the energy consumption. OIHMAC is of centralized cluster head concept. Nodes with the same grade follow the same schedule provided by the cluster heads. So here the neighboring nodes of the cluster head have higher duty scheduling as because the grade value allocation is initiated from the cluster head. The end node gets the least duty scheduling and this will be in sleep state. The data transmissions will here

be as pipelining concept while the higher grid values start the transmission and the lower grid values receives the data. The protocol is made scalable to adapt to the changes in the network which results in high energy efficiency and high throughput.

Status Update Agent for Cross Layer Approach is proposed as a cross layer approach which combines the MAC layer and Network layer parameters. This proposed protocol is used for selecting the optimal link for data transmission. The optimal path is selected based on the highest transmission power of the link. Once after selecting the best path the data rate of the nodes are checked to ensure that it is lower than the flow rate. Too much of data rate may lead to transmission errors and the process of re-transmission. Also by the XOR operation the redundant data transmission is avoided. When the resultant value at the sender and the receiver node is marked as 0 then it indicates the successful transmission and reception of packets. Initially all the nodes are remained to be in the sleep state and the PION frame is flooded to know the sleep status of the node. Therefore this protocol reduces the latency and increases the energy efficiency. In this cross layer status update agent the beacons are used to reserve the channel in advance byHefeida, Canli & Khokhar (2013).

Cross layer decision routing approach is proposed to avoid overhearing by selecting the right link for transmission. This protocol utilizes the MAC layer, Network layer and Transport layer parameters to overcome from the link fading and congestion. The links are selected based on the link usability and node degree. The link usability represents the total number the link used information. The node degree represents the total number of links associated with it. Lesser the node degree, then the overhearing is less. Before every transmission, the link usability and the residual energy of every node are checked, once if the link usability is lesser than the threshold level and if the residual energy is higher than the threshold energy, then the transmission will be initiated. If this condition is not satisfied, then the particular link is discarded and a free link is chosen for transmission. In case of link failures, the Explicit Link Failure Notification (ELFN) message is used to get a new link by sending a RERR message to the neighbours. This cross layer decision routing approach reduces the overhearing and increases the throughput as well as the energy of the sensor node.

Cross layer based opportunistic broadcast coupling technique is proposed to reduce the broadcast overheads. These overheads are reduced by avoiding the unwanted redundant transmissions. The link state information such as link fading and power allocation in the active link are used to overcome from the unwanted redundant overhead

transmission. Suppose if the link fades and fails, then the packet may not be reached at the destination. In this case the sender may sometime assume that the packet loss occurs due to the collision or congestion in the channel. Actually the packet loss happens due to link failures. These problems can be rectified by the link fading information and the power of link. If the fade margin is higher, then the link will be more consistent. This information is got through the MAC layer to the network layer. The proposed cross layer based opportunistic broadcast coupling technique helps in reducing the broadcast overheads and also focuses on producing a higher arrival rate, throughput and energy efficiency with reducing the latency.

In our proposed approaches, the protocols were designed to reduce the energy consumption, broadcast overhead, delay and to improve the throughput. The first protocol Optimal Intelligent Hybrid MAC protocol is designed to reduce the contention period of the sensor nodes and achieves high energy efficiency by moving all the sensor nodes to sleep state until the channel becomes free. The second protocol status update agent for cross layer approach is designed by considering the interaction of the MAC layer and the Network layer. It focuses on reducing the redundant data transmission of packets by using the agent based network coding method. This protocol achieves higher energy efficiency than the optimal intelligent hybrid MAC protocol and reduces the latency. The third protocol cross layer decision routing approach is designed to avoid the link failure path which avoid the excess packet drops. The link failure information is got from explicit link failure notification message. This protocol results in high packet delivery ratio than the previous approaches. The final protocol is the cross layer opportunistic broadcast coupling approach which focuses on reducing the broadcast overheads by utilizing the link fading information. This protocol reduces the broadcast overheads and achieves high energy efficiency. The proposed simulation result shows that each protocol has its own unique functionality in increasing the energy efficiency, throughput, packet delivery ratio and reduces the delay.