NEED FOR VARIOUS ENERGY EFFICIENT MECHANISMS IN THE WIRELESS SENSOR NETWORKS

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ABSTRACT:

Sensor nodes in the wireless sensor networks (WSNs) are of battery made-up. Hence they are provided with limited amount of energy. The battery of a sensor node is un rechargeable and also it is difficult to recharge them manually. Therefore they are to be used in more efficient manner for longer life time. It is difficult to increase the life time of the battery by manually but by implementing some protocols or methods of energy efficiency that can be achieved. Many research works and various protocols have been developed for the past few years in the WSNs. Hence there are various schemes or mechanisms designed for the efficiency of the wireless sensor networks. These things majorly concentrate on the improvement of the energy efficiency of the nodes in the networks where energy is drained out by performing several actions like communicating to the neighbor nodes for the transmission of the packets, by sensing the medium, during the reception of the acknowledgements, during the neighbor node discovery etc. Some protocols have been developed in the regard of providing energy efficiency.

Key Words: Wireless Sensor Networks, Sensor Nodes, Energy – Efficiency.

INTRODUCTION

Wireless Sensor Networks (WSNs) are the networks which are prominently used in the information technology. They consist of the tiny devices with sensors named as Sensor Nodes. The Sensors perform the tasks like – sensing, minor computations and forward the sensed data to the sink or the base station. Mobile Sensor Networks are those which are a class of the WSN and are growing rapidly in the field of various applications. Hence these are having many challenges like – to provide connectivity among the sensor nodes as well as at the same time to maintain the energy consumption at minimum in the sensor nodes as they are made up with batteries where energy cannot be recharged further. Hence these issues made researchers to think and develop various mechanisms in order to provide energy efficiency in the network. Few applications of the WSN are: Home and Office, Control and Automation, Environment Monitoring, Health care, Military, Security and Surveillance etc.

The following lines give an idea about the sensor node – the block diagram, characteristics etc.

1.1 Characteristics of Sensor Node:

The following is the list of characteristics of a sensor node

- ☐ They are tiny in size,
- ☐ Have limited memory size to store the values or queue them before transmitting,
- ☐ Short range of transmission,
- ☐ Low energy capacity,
- ☐ Limited lifetime.

The Fig 1, illustrates the block diagram of the sensor node. It shows how a sensor node is and gives a clear picture of the above listed characteristics of the sensor node.

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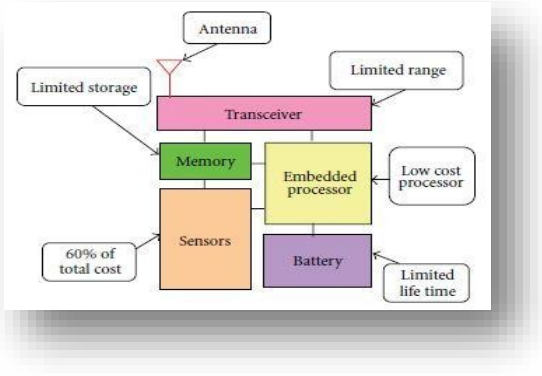

Fig 1: Block Diagram of Sensor Node

1.2 Conceptual Analysis of the Sensor Node:

The sensor nodes are made of batteries which have limited amount of energy and this energy can be neither recharged nor replaced. Therefore it has to be more efficiently used. This is because the most of the energy of sensor node is consumed during the process of Communication with other sensor nodes in the network. Hence the key point is to minimize the energy consumption of the sensor nodes and improve the performance of the network.

II. ROLE OF THE VARIOUS ENERGY MECHANISMS

The energy consumption is the key factor in wireless sensor networks, which is leading the researchers to perform various alternatives in this area to improvise the energy efficiency by making the consumption to minimum and utilize only when needed. The following figure illustrates the various energy mechanisms in the wireless sensor networks.

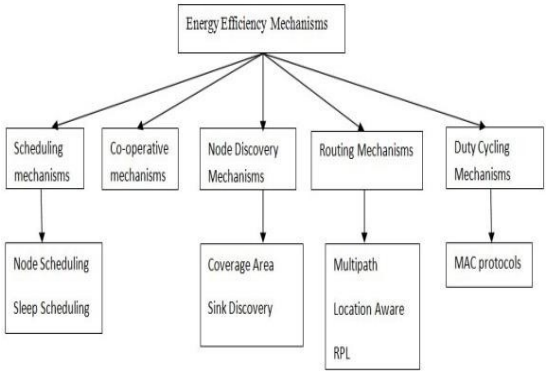

Fig 2: Hierarchical Representation of the Energy Efficient Mechanisms

2.1 Role of Co-Operative Mechanisms

Need of Co-operative Mechanisms: In order to have proper transportation of data among the sensor nodes in the network, there must be cooperation among the nodes. Cooperation mechanism leads to establish sending of data where no data is lost. The following lines make us clear in knowing how the cooperative mechanism is carried out in the wireless sensor network.

Various Co-operative Mechanisms: The energy efficiency is carried out by the coalition-based data transport mechanism where neighboring nodes are organized into groups to form coalitions and sensor nodes within one coalition carry out cooperative communications [20]. The other scheme is that the nodes choose the efficient path selection by relay nodes and then transport the data to the next node [29]. If the medium is of broadcast nature then the network adapts two phase model where in one phase the data transport is sent to the receiver node and if the data is not received by that node then in second phase it is sent through the relay node [24]. Also the cooperation can be based on the two protocols called DRP (Data Reservation Protocol) and PCA (Prioritized Channel Access) where the slot reservation take place and hence the collisions are avoided [15].

2.2 Role of Node Discovery Mechanisms

Need of Node Discovery Mechanisms: One of the important design issues of the wireless sensor networks is to have knowledge about the neighbor nodes and the proper connectivity among them in the network. The following lines describe how the node discovery mechanism is being implemented so far.

Various Node Discovery Mechanisms: By sending the beacon messages the nodes present in the node can be known [13]. Also target discovery plays a major role as the node need to know about the nearby node to which it has to send the data. Thereby, the nodes can be classified into disjoint sets so as to perform the

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tasks in an efficient way [12]. By adapting the selective communication mechanism the node can know about the efficient path in which nodes are capable of handling the data when routed and by having prioritization of the data high priority data can be sent fast whereas low priority can be discarded [23].

2.3 Role of Routing Mechanisms

Need of Routing Mechanisms: To send the data from one node to another series of instructions to be followed, so that there exists some path between the nodes to transfer the data to reach the destination. There by, nodes do spend their energy in locating the path of the nodes to route the packets and hence many routing mechanisms have been proposed by many researchers. The following lines describe about the various mechanisms implemented so far in the wsn.

Various Routing Mechanisms: In routing the packet, the location of a node to which the sender node has to be sent must be known and thereby, location aware comes into existence since all the nodes in the network will be in mobile in nature [2]. When the network is considered with the cluster formation for performing the tasks in more efficient manner, Table maintenance and the cluster head maintenance comes into the picture in order to maintain the consistency of the nodes and their energy information [16]. A New Multipath Routing Approach for the energy efficiency is also proposed in which Route Request control messages can be sent by and controlled[21].

2.4 Role of Scheduling Mechanisms

Need of Scheduling Mechanisms: By scheduling the nodes in the network the amount of energy consumption can be reduced. Scheduling is to be used because there will be division of work among the nodes, also depending upon the scheduling times nodes can be made awake either to receive the data or to send the data.

Various Scheduling Mechanisms: Some of the scheduling are: Wake Scheduling, in which the edge nodes when arranged in grid form are taken into account and are scheduled accordingly [19]. Sleep Scheduling tells that when the nodes are to be in sleep state by sending or making the node to hear the alarm message [8]. Also by coordination of the nodes through implementation of the eligibility of the nodes and by the maintaining the two back-off schemes so that no two nodes remain off at the same time, the energy efficiency can be maintained [6]. By knowing the coverage area of particular number of nodes till where they can sense the data, which can be applicable for large dense wireless sensor networks, can also be considered for the energy consumption [3].Also to avoid blind points when any two nodes switch to off state scheduling algorithms have been proposed [25].

2.5 Need of Duty Cycling MAC Protocols:

Various Duty Cycling MAC Protocols: In the aspect of the providence of the energy efficiency different MAC protocols have been designed namely: S-MAC [4], Q-MAC[17], CF-MAC and H-MAC [5]

Asynchronous MAC for QoS [9], T-MAC[27], EQ- MAC for energy efficient and quality of service providence [1]. P-MAC where patterns are being exchanged between the nodes for communication initiation[6], and also the which tasks can a sensor node handle in a network when the sensor network is designed for multi application scenarios which is being called as task aware protocol, shortly TA-MAC [22]. Instead of beacons, sensor nodes can also make use of the preambles sending, so that other nodes can know when they have to be in sleep state and when they have to be awake [11].

2.6 Importance of Priority Mechanisms:

There are many ways of assigning the priorities to the nodes [30]. Some of them are:

- ☐ ADISK – Local disk currently available in the batch jobs
- ☐ AMEM – Real memory currently available
- ☐ JOBCOUNT – Number of jobs currently running on anode
- ☐ POWER – Depending on the power of the node
- ☐ SPEED – Depending on the processing

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speed it could perform a job

Apart from these, there are different methods of how the priority can be allocated. Priority Hybrid model, which consists of two buffers like event- driven and clock-driven buffers. The emergency packets when received from the other nodes are stored in the event-driven model saying that some event has occurred and the transmission of packets from one to other in a normal way, that are stored in the regular clock-driven model [8]. The priority is assigned in such a way that if there is any real time data then that is send to the highest priority queue and if not then the data in the normal priority is being processed. Also, it is said that the real time data can preempt the data at other queues [10]. An algorithm where there exists three different levels of queues with priorities given. All the real time data packets go to the highest level priority and the non-real time data which has been received from the other nodes go into the second level priority queue and the non-real time data which is at the local node is sent to the lowest priority queue[18]. In addition to, the assigning of the priority by implementing the fuzzy logic where, the data is initially turned into the linguistic values and then stored fuzzy rule base and the decision making like human is done in the inference engine whether to be given highest priority or not[28].

III. CONCLUSION

As the technology has grown into the automatic mechanism, the sensors are part of it. Thereby, several applications of the sensors have been taking place in various fields like – hospitals, crime investigation by vehicle tracking, military, civil engineering, etc. In order to increase the application of sensors widely, the major thing is to design the sensor networks in a more efficient and effective way. In this regard, the major problem faced by the sensor networks is the energy degradation of the nodes which are battery made up and have limited amount of energy which is also not be able to recharged further. All these mechanisms indicate how to maintain the efficiency and the performance of the network by reducing the energy consumption of the nodes eventually of the entire network. These help the researchers to perform research and increase the performance levels of the wireless sensor networks which would be the most benefitted part in the recent technology development where sensor world would be seen in the very few years of the present generation.

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