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Congestion Control in Wireless Sensor Networks

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ABSTRACT: The WSN are the self configured wireless networks. These networks are used to monitor the physical and the various environmental conditions such as temperature, pressure, motion, sound etc. Due to congestion performance of the network degrades. Many algorithms had been proposed to prevent this problem. In this paper, a novel technique has been proposed, a knowledge based technique to control congestion problem.

KEYWORDS: WSN Routing protocol, Congestion.

I. INTRODUCTION

The term wireless network is technically used for any type of network that is wireless in nature. This term is mostly used to refer to the telecommunication network, which shows the interconnection between various nodes that is implemented without use of any wires. The main example of this is the computer network [12], which is a type of telecommunication network. The wireless networks act as the middle man between the wired and wireless network. The wireless access points are basically the base stations which are attached to the wired network. Wireless client act as the network interface. The wireless clients work with the various computer devices such as laptops, pc's that communicate with the access points. Wireless network is of three types:

1. MANET
2. Wireless Sensor Network
3. VANET

MANET stands for mobile ad hoc network. It is a type of ad hoc network, which is used to change the locations. It is also used to configure itself. MANETs may be connected to the local area network or it may be connected to the wide area network [9]. Wireless sensor networks are the collection of the small and the light weight wireless nodes. The wireless sensor networks are the highly distributed networks. VANET is vehicular adhoc network which used to establish communication between vehicles.

(I) WIRELESS SENSOR NETWORK

The WSN are the self configured wireless networks. These networks are used to monitor the physical and the various environmental conditions such as temperature, pressure, motion, sound etc. The WSN network pass their data through the sink, these sinks basically acts as the main location of the network [1]. In this location or we can say sink the data can be observed and analyzed. A sink acts as an interface between the user and the network. If we want to retrieve any information from the network, we inject the queries and the sink gives the required information about the given query in the network.

A WSN consists of hundreds to thousands of the sensors nodes. These sensor nodes consists of the following equipments:-

- A radio transceiver along with an antenna
- A microcontroller
- An interfacing electronic circuit
- An energy source

The sensor nodes communicate with each other by the use of radio signals. A wireless sensor node is equipped with the

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sensing and many computer devices, radio transceivers, and the power component [7].

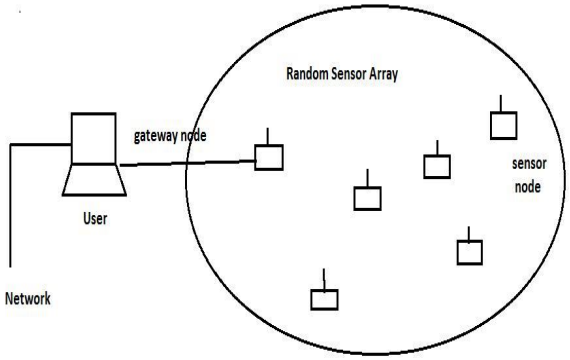

Fig.1.1 Wireless Sensor Network

(II) MAJOR ISSUES IN SENSOR NETWORKS

There are several problems which are faced by the sensor networks. These are as follows:

1. Energy Consumption*:* It is one of the major issues of sensor network. The entire node use battery power as energy source. During communication it consumes more energy. So it is very difficult to change batteries regularly.

2. Localization*:* In the wireless network the sensor nodes are deployed in adhoc manner so they do not have knowledge about their position. The problem of determining the position of nodes is called localization. This problem can be solved by using GPS and bacon nodes [13].

3. Data Gathering*:* Data gathering is a commission of collecting data from different sensor by removing the redundant data. Sensors nodes transfer their own packet and also frontward packets produced by others sensors. Therefore to consume more energy and form the energy holes near the sinks. There are number of security threads in data gathering which are condensed by compression technique and aggregation technique [5].

4. Scheduling*:* It is a major issue of wsn. In this method nodes are switched from one mode to another. Scheduling also plays an important role for coverage and connectivity also. During scheduling from one mode to other, nodes consume energy [3].

5. Load Balancing*:* Due to congestion in the network because of some faulty nodes load imbalance problem occurs. It leads to the failure of the network.

In this paper we will discuss about congestion in Wireless Sensor Network in detail.

II. RELATED WORK

In [11] H.Dubois-Ferries et.al proposed an algorithm based on Voronoi clusters to handle multiple sink nodes. This Voronoi algorithm designates a sink for each cluster to perform data acquisition from sensors in cluster. Each node keeps a record of its closest sink and of the network distance to that sink. When a message arrives from a sink, the recipient checks whether the distance traversed by the packet is less than the current estimate of closet sink distance. If so, the node updates its closest sink and parent entries and resends the message. A node also re-forwards the message if the distance traverse is equal to closest distance and the message came from the closet sink. A drawback of this algorithm is that it does not consider residual energy sensor node.

In [12] Hemant Kumar Rath discussed a cross layer congestion control technique of TCP Reno-2 in wireless networks. In this both TCP layer and PHY layer jointly control congestion. The PHY layer changes transmission power as per the channel condition, interference received and congestion in the network, whereas the TCP layer controls congestion using Reno-2 window based flow control. Our simulations show that the cross layer congestion control technique provides performance improvement in terms of throughput and window size variations.

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In [2] Anand Balachandran et.al explained about Wireless LAN administrators are often called upon to deal with the problem of sporadic user congestion at certain popular spaces within the network. To address this problem, they describe and evaluate two new approaches, explicit channel switching and network-directed roaming for providing hot-spot congestion relief while maintaining pre-negotiated user bandwidth agreements with the network. The goals of these algorithms are: (i) to accommodate more users by dynamically pro-viding capacity where it is needed, when it is needed; (ii) to improve overall network utilization by making more efficient use of deployed resources; and (iii) to guarantee at least a minimum amount of bandwidth to users. They propose that both the network and its users should explicitly and cooperatively adapt themselves to changing load conditions depending on their geographic location within the network. They describe how these algorithms enable the network to transparently adapt to user demands and balance load across its access points (APs). They evaluate the effectiveness of these algorithms on improving user service rates and network utilization using simulations. Their algorithms improve the degree of load balance in the system by over 30%, and user bandwidth allocation by up to 52% in comparison to existing schemes that offer little or no load balancing.

In [7] Bret Hull described an experimental evaluation of three complementary congestion control strategies for wireless sensor networks. They show that unless a sensor network operating under load has some means of controlling congestion, it will face significant degradation in efficiency and fairness. As network load increases, or when channel variations cause fluctuations in achievable bandwidth, nodes must modulate their send rates based on local congestion feedback or the network will go into congestion collapse. They evaluate three techniques for mitigating congestion both in isolation and in concert. Their results show that hop-by-hop own control with a simple queue occupancy-based congestion detection method orders substantial efficiency improvements for all types of workloads and utilization levels. This including holds because a successful wireless transmission requires both the sender and receiver to be contention-free with respect to both the wireless channel and queue space. Implementing a rate-limiting policy results in substantial improvements to fairness. Finally, MAC enhancements support the operation of hop-by-hop own control.

III. CONGESTION IN WSN

To maintain and allocate network resources effectively and fairly among a collection of users is a major issue. The resources shared typically are the bandwidth of the relations and the queues on the routers or switches. Packets are queued in these queues awaiting transmission. When too many packets are challenging for the similar link, the queue overflows and packets have to be dropped. When such drops become common events, the network is said to be congested. Congestion control methods [7] can be router centric or host/node centric. In existing congestion control methods, the source is informed about the congestion in the network so that either it may slow down the packet transmission rate or find an alternate route which may not necessarily be an optimal route. It must be pointed out that all the congestion control methods are able to inform the source about the congestion problem because they use Transmission Control Protocol. The communication between sensor node to sink is based upon multi-hop message relay. The batteries of the sensor nodes placed near the sink will exhaust faster as compared to those that are placed far away [5]. This is because nearby sensors are shared by more sensor-to-sink paths, heavier message relay load and therefore consume more energy. Energy depletion causes energy holes which degrades the network performance. Researchers have developed many energy models to give proper explanation but these models still need to be improved. Clustering technique in routing protocols plays a key role to prolong the stability period and lifetime of the network. In the clustering technique of wireless sensor network, the communication can be done from cluster head to cluster head.

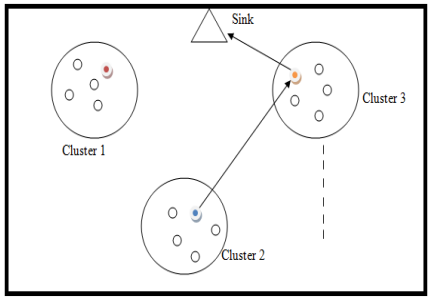

Fig.3.1 Congestion in WSN

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IV. PROPOSED METHODOLOGY

Clustering technique in routing protocols plays a key role to prolong the stability period and lifetime of the network. In the clustering technique of wireless sensor network, the communication can be done from cluster head to cluster head. This technique will reduce battery consumption and increase packet overhead in the network. The load in the network can be equally divided between the cluster heads for efficient working of the network. In the network, when the load will be imbalanced the battery consumption of the cluster heads may increase which directly reduces the network lifetime. The load imbalance condition in the network may arise when the congestion in the network increases. The congestion can be decreased, when the bottleneck can be created in the network. In this work, we will remove the problem of congestion in the wireless sensors for efficient working of the clustering techniques. In present work to overcome congestion problem knowledge based learning will be used. In existing work, path were established on the basis of minimum hop count and fresh sequence number. As we discussed earlier there is a problem of congestion in this path because there is no knowledge of congestion occurrence in advance. So to remove this problem a novel technique is proposed, in which path is established on the basis of minimum congestion counter. The existing and proposed idea will be implemented in NS2.

V. EXPERIMENTAL RESULTS

In fig 5.1 red lines shows new methodology packet loss and green line shows old methodology packet loss. It shows that proposed methodology is better than existing one. Packet loss occurs when one or computer network fail to reach their destination because of congestion which occurs when the amount of traffic destined for a particular link exceeds the capacity of that link.

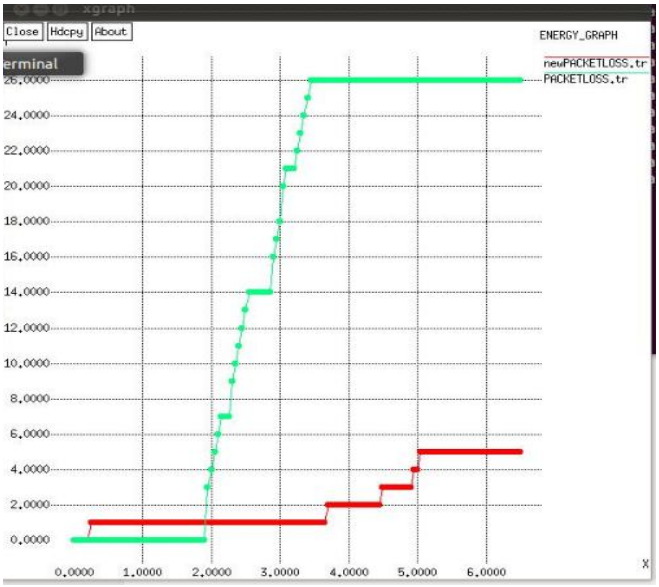

Fig. 5.1 Packet Loss Graph

By using the technique of knowledge based learning, the packet loss of the network decreases as the knowledge about congestion occurrence, is obtained in advance. This improves the efficiency of the system.

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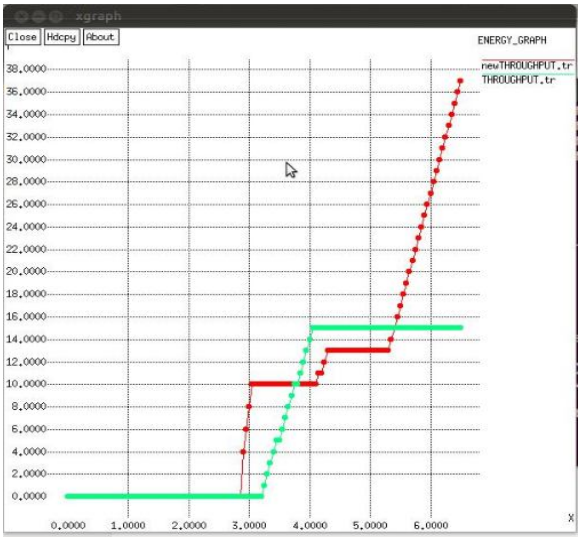

Fig.5.2 Throughput Graph

In fig.5.2 red lines shows new methodology throughput of the network and green lines shows old methodology throughput. It shows that proposed methodology is better than existing one due to increase of the throughput of the network. Increased throughput leads to successful delivery of messages over a communication channel. This is made possible by using proposed technique in which path is established on the basis of minimum congestion counter which leads to reduced packet loss and hence increased network throughput. This leads to improved system performance.

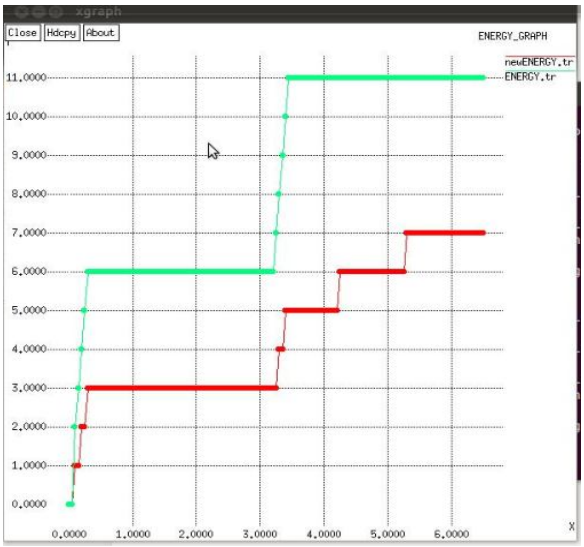

Fig.5.3 Energy Graph

In fig. shown above, red lines shows new methodology energy consumption and green line shows old methodology energy consumption. The graph shows that proposed methodology has proven to be better than the existing one. We know that generally irreplaceable energy sources in sensor node limit lifetime of the whole system. Energy is a factor of outmost importance in WSNs. So energy consumption should be less in any network which increases the lifetime of the whole network. Using the proposed technique has lead to reduced energy consumption of the wireless sensor network.

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VI. CONCLUSION

In this paper, we conclude that congestion is dangerous for successful delivery of data packets. Due to this packet loss may occur and delay increases. The main objective of the paper is to control congestion so that packet loss and energy consumption can be reduced and throughput of the network can be increased. Experimental results show that proposed method is far better than existing method as it has less energy consumption and less packet loss as compare to the existing technique.

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