International Association of Scientific Innovation and Research (IASIR)
(An Association Unifying the Sciences, Engineering, and Applied Research)

ISSN (Print): 2279-0047
ISSN (Online): 2279-0055

International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)

www.iasir.net

Load Balancing Method for Wireless Sensor Network

Suman Mor[1] and Mr.Vinod Saroha[2]
M.Tech,CSE Deptt.
B.P.S.M.V.,Khanpur Kalan
Sonipat,Haryana
INDIA

Abstract: *By Distributing load on the surrounding nodes in the sensor network leads to the elimination of overload of center node. This results in the increase in the energy life span of the node and network and also prevent from the formation of holes in the network. In this paper, we design a load balancing algorithm that results in elimination of congestion on center node. We find that our algorithm achieves the load that is more effectively balanced than the horizontal-Vertical routingt.*

Keywords: *sensor node; wireless; grid; expansion; compression; load; overload.*

I. Introduction

With the rapid development in the low cost sensing devices, wireless sensor networks (WSNs) have recently emerged as an active research area. Wireless sensor network consists of a large number of low cost, low power and multi functional sensing nodes that sense the environmental activities and work collaboratively to process and route the sensor data.[1][3]WSNs are suitable for a large number of applications including battlefield monitoring, habitat monitoring, tracking of office equipment and environment surveillance. These sensor nodes have sensing component to collect the information, power supply unit, communication unit to transmit and receive data and processing unit. As these sensing units are low battery-powered that's why it is very important to minimize the power consumption of wireless network. A great concern in WSNs is the distribution of networking load effectively as a sensor network scale up in size. Load balancing averages the energy consumption by spreading the workload across the sensor network. This helps in extending the expected lifespan of the whole sensor network by extending the time until the first node is out of energy. With the help of load balancing we can reduce the congestion hot spots by reducing wireless collision.[5]
In this paper we are going to develop an algorithm for load balancing in N*N grid wireless sensor network. In this we consider All to All communication mode where every node can receive and transmit to all remaining node of that network. In this type of network, we transmit by a shortest path that results in the overload or congestion on very center node. So due to this overloaded node whole network collapse in a very short time. To balance this load, we distribute the load on surrounding nodes. To explore this problem, we consider both the case: in static case which have no failed node and in dynamic case, there are some nodes which are failed. In the static case we implemented the Horizontal-Vertical method for finding the efficiency of new algorithm. In dynamic case, success ratio is much more important than the load balancing in the network.

II. Load Balancing in WSNs

In the network when load on a particular node exceeds than a threshold value, which is 50% of the initial energy of that node, then that node is considered as overloaded node. Due to congestion on a single node results in the discharge of that node at a very high rate as compared to other nodes. Due to uneven load distribution in the network, holes are created [3]. Due to these holes efficiency of the network degrades and also responsible for the loss of packets. So routing in the sensor network is one of the important issue and many difficulties are faced during deployment of routing strategies. These routing strategies are affected by irregular topologies. In order to avoid this problem regular topologies are preferred over irregular one.
An efficient routing approach should be developed which avoid the congestion on some nodes and also prevents from the formation of holes [6][7][11][12].

III. Routing Strategies in WSN

To provide load balancing in All to All communication scenario, little work is done. The main reason behind is that load balancing is considered as NP-Hard problem. Shortest path routing and load balancing are always conflicted. Shortest path routing works on under utilization of some nodes whereas load balancing is related with the utilization of all nodes efficiently.

A. Servetto Method

Servetto gave a spreading algorithm which reduce the load over the central node and distribute the load on the corner nodes. This method is applicable when there is single source and single destination. Results are found

suitable only in these cases. But in All to All communication it is observed that the central node is highly loaded [7].

In this method, all nodes are considered as they belong to a diagonal. Then whole load is equally distributed on that diagonal. The network is divided in two stages comprised of expansion and compression phase.

- Expansion phase: In this load per node of a diagonal keeps decreasing.
- Compression phase: In this load per node of a diagonal keeps increasing as we moves towards the destination.

B. Horizontal- Vertical(H-V)Routing Method

In this H-V method ,firstly the message is routed horizontally until the intermediate node is reached and then message is routed vertically until destination is reached. In case if there is choice of path between horizontal and vertical path ten in that case horizontal case is preferred.[9]

C. *Zig Zag routing Method*

In this type we are following a route which is of zigzag pattern. When are not able to follow a zig zag path then in that case we follow either horizontal or vertical path which better suits in order to reach at the destination. In this method corner nodes are less utilized and load over the nodes increased as we move towards the center node. The total load is equal to the total load in horizontal-vertical method.[6]

IV. Proposed Load Balancing Algorithm

In this section we are discussing an algorithm which effectively distribute the load to the surrounding nodes of the center node in N*N grid network.

LOAD_BALANCING_ALGO(A,B,N)

/ A-source node B-destination node N-size of network*/*

```
{
Step 1.By using Horizontal-Vertical routing,(H-V(A,B)),find out the shortest path between source node A to
destination node B.

Step 2. Maintain a list of all routing nodes in the path named L(l1,l2,l3.ln).

Step 3. For each node C of the list L
        {
         If (Load(U)>Threshold value)
         Then
         Find out compromising nodes of U node,called a List C
         Find out distributable load on each node LoadD=Load(U) –Threshold value
         For(each I in C)
            {
            If(Load(I)+LoadD<Threshold)
               {
                  Load(I)=Load(I)+LoadD
               }
             }

Step4. If (packetloss(U)>Minload)
        {
           Eliminate node U
         }

Step5.Else continue transmission using Horizontal-Vertical approach
}

Horiz-Verti(A,B)

/* A is source node and B is destination node*/
/* suppose destination node is at right corner */
```

Step1. If(A=B)
Print("Destination is found") and exit

Step2. If(Right(A)!=null)
{
Set C=Right(A)
/ set Right node as the current node*/*
}

Step 3.If(Down(A)!=null)
{
Set C=Down(A)
*/*set Down node as current node*/*
}

Step4. Go and repeat step 1
.

V. Simulation and Performance Analysis

In this section, we are going to discuss the simulated result. We use NS2 simulator to perform all the implementation. In this we implement the existing H-V approach and also the proposed load balancing scheme so that their performance and efficiency is evaluated. Here are some of the graphical results which show that the performance of suggested load balancing algorithm is far better than the existing scheme.
In this section, Xgraph are shown in which X-axis shows the time in seconds and Y-axis shows the number of packets.

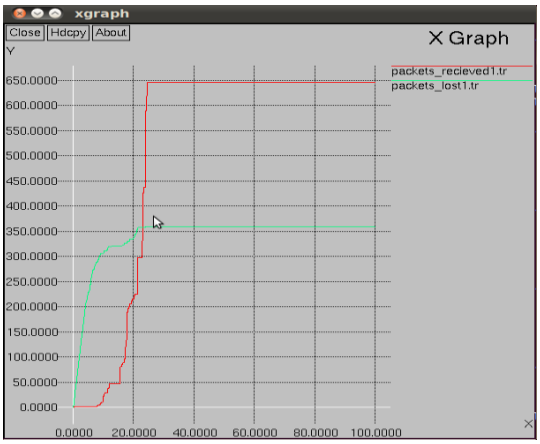

Fig1.Xgraph shows the received and loss of packets in existing approach.

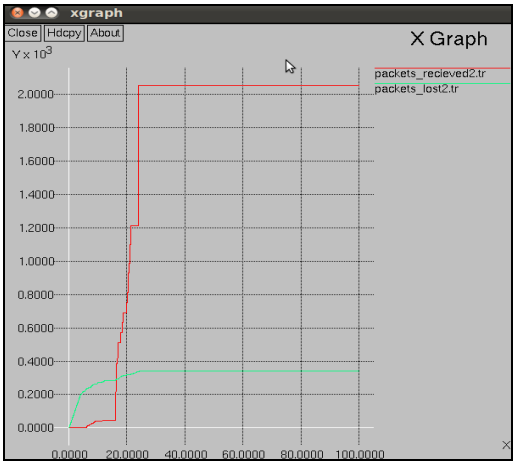

Fig2.Xgraph showing the received and loss of packets in proposed scheme.

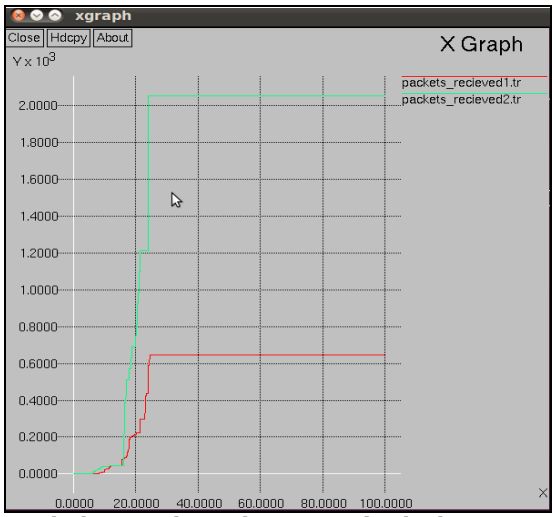

Fig3.Xgraph showing the packet received in both routing scheme.

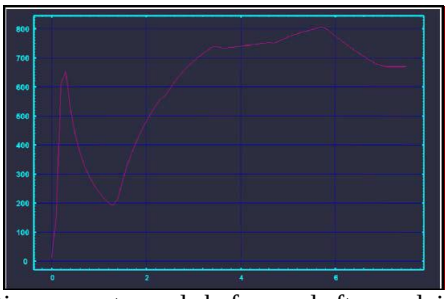

Fig4.Xgraph showing the variation on center node before and after applying the load balancing algorithm

Fig1. shows the received and loss of packets when we apply H-V method. The red line shows the packets received with respect to time and green line shows the packet loss with respect to time.Packets_lost1.tr are the trace file which include packet loss with respect to time.Packets_received1.tr is the trace file which include the packet received with respect to time.

Fig2 shows the received and loss of packets when we use the proposed load balancing algorithm. The red line shows the received packets with respect to time and green line shows the packet loss with respect to time.Packets_lost2.tr is the trace file which include packet lost with respect to the time.Packets_received2.tr is the trace file which have received packet with respect to time.

Fig3 Xgraph shows the packet received in both the strategy. The red line shows the packet received in the existing scheme and green line shows the packet received in proposed scheme with respect to time. The Xgraph clearly shows that the packets received in the proposed scheme are more than the existing scheme.

Fig4 Xgraph shows the variation on center node before and after applying the load balancing approach. X-axis shows the timing and Y-axis shows the load. In the starting center node works very well as after some time it starts overloaded and performance degraded. At that point load balancing scheme is applied and the performance starts increasing.

VII. Conclusion

In this paper we evaluate H-V algorithm and Find out its limitation of overloaded center node. To remove this we proposed an efficient load balancing algorithm and to find out its performance we use NS2 simulator. After evaluating the existing and proposed results we came to a conclusion that proposed scheme is far better than existing H-V scheme. To increase the life span of the network and the node we have to prevent network from the congestion or overloading any node. To remove the overload on center node we distribute the load on the surrounding node. This helps in increasing the lifespan of the network.

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