A Study and Development of Distance Based Node Deployment Algorithm for Efficient Network Transmission

Dr. K. Pavithra
Department of Computer science, Pollachi College of Arts and Science, Poosaripatti

***Abstract* - The Network congestion in the nodes is the primary reason for packet loss and delay in the network. TCP use various congestion control algorithms like delay based and loss based to eliminate and control the congestion. In wireless sensor networks (WSNs), traffic control also be another cause for network delay and packet loss. The Congestion control and avoidance manipulate the traffic within the network. The Node Deployment plays the major contribution of reliable data transaction without congestion and placement of nodes can be of three major categories depending on the nodes are placed in the network. They are the deterministic (Grid), the semi deterministic and non deterministic (Simple diffusion, Random) node Placement [4],[5]. Normally in the deterministic way, the nodes are fixed in static position and it cannot be flexible in all environments. In non deterministic way, the nodes are deployed randomly and it can create collision in network topology.**

***Index Terms* - Distance based algorithm, Node deployment, congestion control, WSNs.**

1.INTRODUCTION

Wireless sensor nodes are small in size having predefined functions and computing capability to interact with sensors and communicate using restricted wireless transmitters [1]. These nodes work automatically and generate a logical network in which the data packets can be transferred based on the nodes placement[2],[3]. Hence this work mainly concentrates on node management because node placement plays the major role of reliable data transmission without congestion in the network. This method is an inspiration of Bird flocking [6] [7] congestion control algorithm. In Bird flocking method, magnetic tool is used to find the node position and follow the perfect node distance. The proposed method maintains a safety node distance between the nodes and also concentrates repulsion and attraction to avoid node congestion without using magnetic tool. The method use the distance based node management for data transmission in the network.

In the proposed work, the Semi deterministic (Semi Random) technique is used to control the congestion and loss of packet. It compared with Sen-TCP (Sensor based TCP) [9], Directed diffusion and HTAP (Hierarchical Tree Alternative Path). The Sen-TCP is an open loop hop by hop congestion control protocol. In Sen-TCP, each intermediate sensor node can send the feedback signal backwards and hop by hop. The Directed Diffusion [8] is a data centric protocol because all the communication done using its named data. All the nodes in a directed diffusion are aware of the application. This enables to save energy by choosing empirically best paths by caching and processing the data in network. HTAP [10] is scalable and distributed framework to minimize the congestion and assuring reliable data transmissions in event based WSNs. It does not have the rate limitation. The above said techniques works well in random and static node placement. It fails when the distance of the available nodes change. So, the congestion definitely occur in the network topology. The proposed algorithm Distance based Node Deployment Congestion Control can be used to avoid congestion in the network. The node moves towards a safety direction to avoid congestion on the network topology.

II. PROPOSED ALGORITHM: DISTANCE BASED NODE DEPLOYMENT ALGORITHM

A wireless sensor network is nothing but the high number of potential nodes which may be travelled over a huge physical area. Wireless Sensor Network node moves in a random or static but both of movements face some problems and finally results in congestion [11]. Congestion control and avoidance manipulate the traffic within the network. Node Placement plays major role for reliable data transaction without congestion. Sometimes the distance between each node can be the factor which results in the network congestion.

Algorithm 2.1: Distance Based Node Deployment Algorithm
1. *Initialization (x, cur x, cur y, max x, max y, mid val, oldcur val, nearval, cur val, i, n), (max X) , (max Y),(max nodes)*
2. *Data transaction*
3. *Event on no time out do*
4. *Find max x, max y, midval, nearval, curval, old curval*
5. *Mid val = max x/2, max y/2 (1)*
6. *Curval = old curval- near curval mid val > old curval (or) Nearval – old curval ,mid val < old curval*
7. *If I <= n then If curval = nearval then*
8. *No change fix the node*
9. *Else if nearval – curval old curval then*
10. *Go to no change*
11. *Else*
12. *End*

The proposed method mainly concentrate favored the repulsion and attraction between the nodes in the network. It can create the distance between the nodes in a network area and arrange the node without collision. The Mid value and nearest value of total nodes can be uses to create the node distance between the nodes. Mid value and nearest value of the total nodes are calculated as follows,

$$pos_i^{(midval)} = \sum_{i=0}^{n} \frac{Max(Xi, Yi)}{2} \qquad (1)$$

$$pos_i^{(nearval)} = \sum_{i=0}^{n} pos_i^{(midval)} - pos_i^{(min\,diff)} \qquad (2)$$

Where, $pos_i^{(midval)}$ is Midvale of total nodes, are *X and Y* value of the network map, n is the number of nodes and *i* is the node position. All nodes can be fixed initially in the simulation area. Next check the time out event, if time out occurs the node should complete the process otherwise it will enter into the process. The max X value, max Y value, current node position, old position (random position), mid position and near value can be taken from the allocated nodes. Current position (value) and old position (value) are calculated from mid node (value). If current node position is higher than the old position, then no changes happened and fix the old position otherwise fix the current position. By doing the above said repeatedly the changed position of nodes perfectly fit the best repulsion and attraction combinations. Finally this algorithm leads those nodes without congestion. Algorithm 7.1 shown below describes the distance update process of random nodes using semi deterministic way.

III. ILLUSTRATION OF PROPOSED SCHEME

A network model is taken as sample in the wireless network to illustrate the proposed scheme as shown in Figure 3.1.

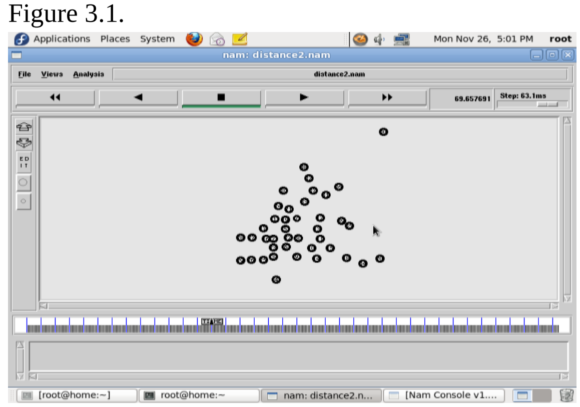

Figure 3.1: Distance Algorithm based node Deployment process

From the Figure 3.1, discover the distance routing but the nodes randomly deployed in wireless network in starting stage and movement based on repulsion and attraction in the Wireless network. In network area distance algorithm forms non congested nodes for data transmission. First this method finds the mid node and arranges and changes the position of remaining nodes near to the mid node from random placement.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The performance of various node deployment techniques are evaluated using NS 2.34 [12]. Table 4.1 illustrate the simulation model and the simulation parameters respectively. The results of the simulation are generated as trace files prepared .awk scripts to analyze the trace files into graphs with various performance metrics. The performance metrics analyzed are Packet delivery fraction, Packet loss Ratio, Routing Overheads and Throughput.

Parameter	Value
Simulator	NS-2.34
Simulation time	100 seconds
Simulation Area	800x800 m^2
Transmission Range	250 m
Packet Size	512 bytes
Traffic & Mobility model	CBR/TCP
Traffic Rate	10 packets/second
Simulation Model	Random Way Point
Pass Time	5 seconds
Number of nodes	70
MAC Type	802.11 DCF
Channel Type	Wireless Channel
Routing Protocols	DSDV
Network Load	4 packets/sec.
Radio Propagation Model	Two Ray Ground
Interface Queue Length	50
Interface Queue Type	Drop Tail / Pri Queue

Table 4.1: Simulation Parameters

4.1 Packet Delivery Ratio Analysis

The amount of packet delivery can be calculated by taking the ratio of an amount of successive received packets of a destination node with an amount of transmitted packets by a source node during the particular time which defined in simulation.

Table 4.2: Packet Delivery Ratio of Various Node Placements (%)

Number of Nodes	Grid	Simple Diffusion	Random	Semi Random
20	49	52	49	70
30	69	72	60	82
40	77	75	65	86
50	75	77	70	89
60	74	80	72	93
70	79	82	74	96

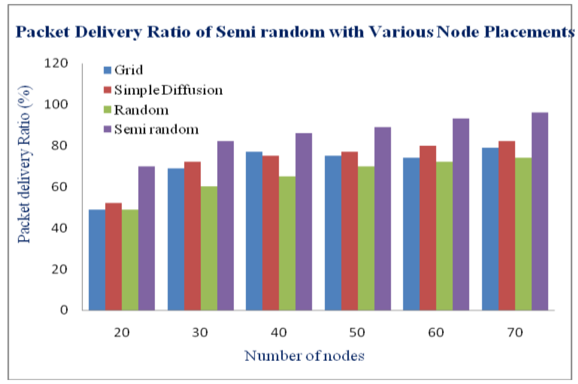

Figure 4.1: Packet Delivery Ratio of Semi-random with Various Node Placements

From the Table 4.2 and Figure 4.1 shows the packet delivery details of Semi random mechanism with various node deployment mechanism. In Semi random method, the packet delivery rate is high compared with other mechanism because this algorithm use non congested repulsion and attraction of nodes in data transmission to avoid data traffic. Hence the packet delivery increases automatically.

Table 4.3: Packet Delivery Ratio of Various Node Placements (%)

Number of Nodes	Sen-TCP	Direct diffusion	HTAP	Distance
20	67	65	68	70
30	74	70	77	82
40	85	89	88	86
50	78	86	84	89
60	86	87	90	93
70	92	89	91	96

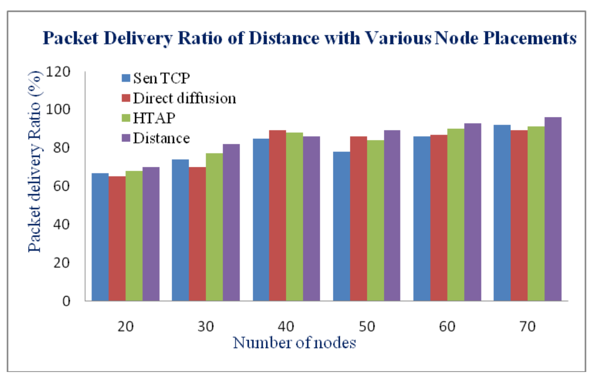

Figure 4.2: Packet Delivery Ratio of Distance with Various Node Placements

From the Table 4.3 and Figure 4.2 shows the packet delivery details of various node deployments with distance mechanism. In Distance method, packet delivery rate is high compared with other mechanism because it use non congested repulsion and attraction in data transmission to avoid traffic. Hence the packet delivery increases automatically.

4.2 Packet Loss Ratio

The reason for packet drops can be network traffic, congestion and delay. Here the Distance based node deployment used to avoid unnecessary traffic, control the delay and packet loss.

Table 4.4 Packet Loss Ratio of Various Node Placements (%)

Number of Nodes	Grid	Simple Diffusion	Random	Semi Random
20	51	48	51	30
30	31	28	40	18
40	23	25	35	14
50	25	23	30	11
60	26	20	28	7
70	21	18	26	4

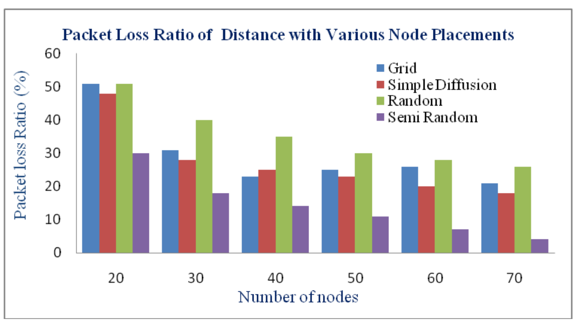

Figure 4.3: Packet Loss Ratio of Semi-random with Various Node Placement Techniques

The result obtained from the simulation is given in Table 4.4 and Figure 4.3 correspondingly. Semi-random has lesser packet drops compared to various other node deployments during data transmission. Because the Distance based technique use non congested repulsion and attraction in data transmission to avoid traffic and packet loss.

Table 4.5: Packet Loss Ratio of Various Node Placements (%)

Number of Nodes	Sen-TCP (in %)	Direct diffusion (in %)	HTAP (in %)	Distance (in %)
20	33	35	32	30
30	26	30	23	18
40	15	11	12	14
50	22	14	16	11
60	14	13	10	7
70	8	11	9	4

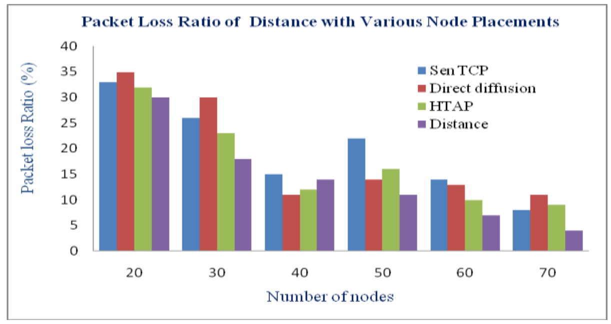

Figure 4.4: Packet Loss Ratio of Distance with Various Node Placement Techniques

The result obtained from the simulation is given in Table 4.5 and Figure 4.4 correspondingly. Distance has lesser packet drops compared to various other node placement techniques during data transmission. Because distance follows non congested repulsion and attraction in data transmission to avoid and control packet loss.

4.3 Throughput

Throughput is obtained by calculating number of packets received at the destination from the source at a specified network time (kbps).

Table 4.6: Throughput (kbps)

Number of Nodes	Grid	Simple Diffusion	Random	Semi Random
20	91.23	118.8	90.65	100.12
30	131.14	128.73	125.41	135.45
40	149.74	155.32	155.07	168.62
50	165.6	163.1	160.8	177.11
60	168.52	170.5	161.4	181.72
70	167.43	176.34	158.8	190.53

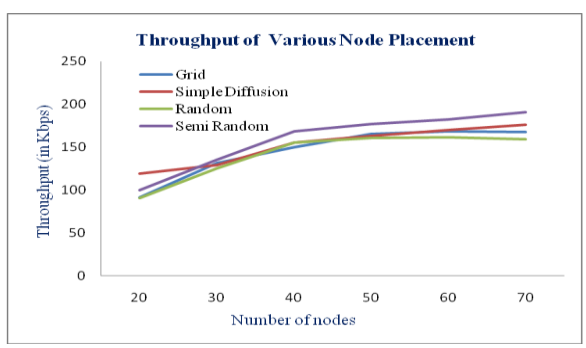

Figure 4.5: Throughput of Semi-random with Various Node Placements

From the Table 4.6 and Figure 4.5 shows the throughput of each algorithm in packet delivery fraction. In Semi random based node Deployment, throughput becomes high while other are less if the node scalability increases. During network congestion in other node deployment causes high packet delays and more overheads maintain data loads.

Table 4.7: Throughput (%)

Number of Nodes	Sen-TCP	Direct diffusion	HTAP	Distance
20	121.12	128.4	139.81	100.12
30	134.09	128.73	145.41	135.45
40	157.34	145.74	166.57	168.62
50	164.63	161.87	170.81	177.11
60	178.82	178.05	169.42	181.72
70	184.43	183.9	181.23	190.53

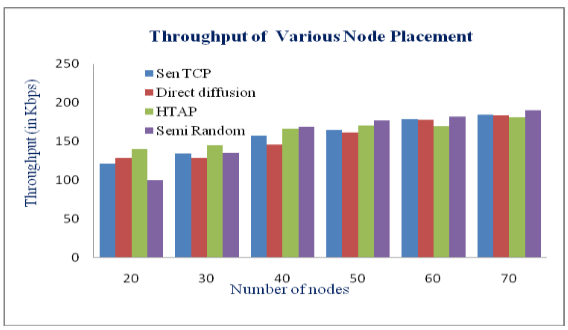

Figure 4.6: Throughput of Distance with Various Node Placements

From the Table 4.7 and Figure 4.6 shows the throughput of each algorithm in packet delivery fraction. The Distance based node deployment throughput becomes high when node scalability increases. Because it use non congested best repulsion and attraction between nodes to avoid congestion and packet loss.

CONCLUSION

The proposed method Distance based node placement algorithm balance the network flows and traffic on the network paths efficiently. In the existing node movement process, it can be broken due to network traffic and leads to congestion issue. To overcome this issue, the new distance based best repulsion and attraction technique is introduced to limit the traffic load and network delay. So the congestion and contention problem can be reduced. In Distance based node placement, traffic over different wireless links can be controlled and maintain safety paths in the network. It prevents congestion in the network. From the simulation result, the proposed scheme Distance based node placement is better than the existing node placement techniques with respect to Packet delivery Ratio, Packet loss Ratio, Throughput and Routing Overheads. The Distance node deployment technique reduces routing overhead and packet loss with respect to the number of nodes. It also increases the packet delivery ratio and throughput when compare with various other node placement techniques.

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