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Strong Link Establishment in Wireless Ad hoc Network using Position based Re-configuration

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Abstract—In this paper, we analyze the nature of links among various sensor nodes which is subjected to dynamic reconfiguration .This may arise due to occurrence of adverse constraints in the deployed environment. As a result the communication frame-work gets influenced and needs to be modified from time to time. The suggested scheme deals with finding the number of strong and weak links for each node to every other node. The network characteristic is studied over a period of time and displacement of nodes assumed to be random. This information can be further utilized to modify the routing table for transmission across the strong links so that the node saves energy and remain active for a longer period of time.

Keywords— dynamic WSN, ad hoc network, strong link, weak link, head node

I. INTRODUCTION

Wireless Sensor Networks (WSN) is a new computing paradigm that is based from the combination of the supervisory control and data acquisition systems and ad hoc network technologies. WSN are increasingly attractive system to detect, monitor and control environmental conditions. Wireless sensor network consists of a large number of small inexpensive disposable and autonomous nodes that are generally deployed in ad hoc manner in vast geographical for remote operations. WSNs have a variety of applications of distributed wireless sensing including medical, home security, machine diagnosis, military applications, vehicular movement, environmental monitoring, biological detections, soil makeup, noise levels, mechanical stress levels on attached objects and the current characteristics such as speed, direction and size of the objects.

Support for very large numbers of autonomous mobile nodes, adaptability to environment and task dynamics are fundamental problems of WSNs as they have limitations of dynamic network topology, limited battery power and constrained wireless band width. The configuration of sensor nodes would frequently change in terms of position, reach ability, power availability etc. As the nodes interact with physical environments they would experience a significance range of task dynamics.

Node mobility, node failures in establishing a link with neighbour node, environmental obstruction cause a high degree of dynamics in WSNs. these include frequent network topology changes and network partitions. WSNs will exist with the plenty of nodes per user. At such heavy quantity, nodes may be in accessible, since they are incorporated in physically structures or thrown into hostile terrain. Thus for a effective system, it must provide self configuration functionality.

In this paper, we compute the Euclidian distance between pair of nodes and subsequently decided the link to be weak or strong if the distance exceeds a threshold. Further the method find out the head node with maximum strong links in the network. This information can be utilised to select a cluster head and to update the routing table for using the strong links for transmission. This will enable the WSN to minimise the transmission failures and improve the stability and longevity of the network.

The paper is organised as follows. Section 2 outlines the related work and the system model. In Section 3 we present the proposed algorithm for finding the strong and weak links. Section 4 deals with simulation and results. Finally, Section 5 presents the concluding remarks.

II. RELATED WORK

Woo et al [7] investigated reliable multi-hop routing in WSNs. Their recommendation includes the use of PRR as link quality metric for link estimators, interpreting the minimum data transmission route as link availability indicator and using the number of transmission from source to destination as a routing metric. in this they didn't evaluate the number of strong links required for transmission can be optimized in dynamic network configuration.

Woo and D.Culler [8] examined their study for settling time for good and bad links among the nodes. it does not perform for well links for intermediate quality[9].Sun et al[10]considers the WSN network is a homogenous network density in terms of links is distributed uniformly throughout the area. But practically a dynamic WSN is ad hoc in nature can not be homogenous rather is heterogeneous. So in a heterogeneous dynamic network density is not uniformly distributed which leads the failure of transmission of packets from the differential part of the area where no maximum strong links are there. That is why it needs to find out the more links per node to forward the message.

III. SYSTEM MODEL

We model the wire-less ad hoc network of n nodes deployed in 2-D (x & y polar co-ordinate.) area, where no two nodes are in the same position. We assume each node is aware of its own position through of GPS device. We further assume the existence of location management services so that each node is aware of the positions of other nodes. Finally we assume the nodes may be mobile i.e. positions of nodes may change over time in each reconfiguration as in a random work model.

We assume the dimension of 2-D area as $L \times L$ where L is the length of the area. We consider the model in which there are two types of links being established among nodes either strong link on weak links or strong and weak links both. We assume two threshold range values as $R_{TH(S)}, R_{TH(w)}$ representing the ranges for strong link and weak link respectively.

We consider two nodes in 2-D plane, denoted by $N_i, N_j \quad i, j \in n \quad i \neq j$. In order to find out the distance between any two consecutive nodes N_i, N_j, we take the parameter *DIST* which indicates the Euclidean distance between any two consecutive node N_i, N_j defined as,

$$DIST = \sqrt{\left(x(N_i) - x(N_j)\right)^2 - \left(y(N_i) - y(N_j)\right)^2} \qquad (1)$$

$x(N_i), y(N_i)$ represents position coordinates of node N_i and $x(N_j), y(N_j)$ represents position coordinates of node N_j.

Algorithm 1: Finding the distance between the nodes

```
Find_DIST ( N_i , N_j )
For each node N_i  i,∈ n
{
        x(N_i) =random value(1,n)*L
        y(N_i) =random value(1,n)*L
}
DIST = sqrt((x(N_i) − x(N_j))^2 − (y(N_i) − y(N_j))^2)

Return(DIST)
```

Next Comparing the distance value *DIST* to the threshold ranges $R_{TH(S)}$ & $R_{TH(w)}$.

Comparision-1: For $DIST \leq R_{TH(S)}$, link being established is strong one.

Comparision-2: For $R_{TH(S)} < DIST \leq R_{TH(W)}$, link being established is weak one.

Further if $DIST > R_{TH(w)}$, then no link should be there between nodes N_i and N_j.

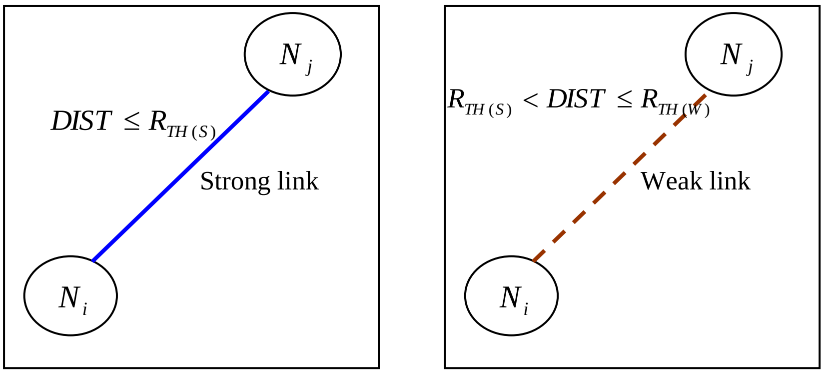

Fig. 1: Strong link and weak link between nodes

We take two matrices as *MSL* and *MWL* for nodes having dtrong links and weak links respectively. The cells of matrices are assigned to 1 if there is a link between the nodes N_i and N_j. Otherwise it is infinite for no link.

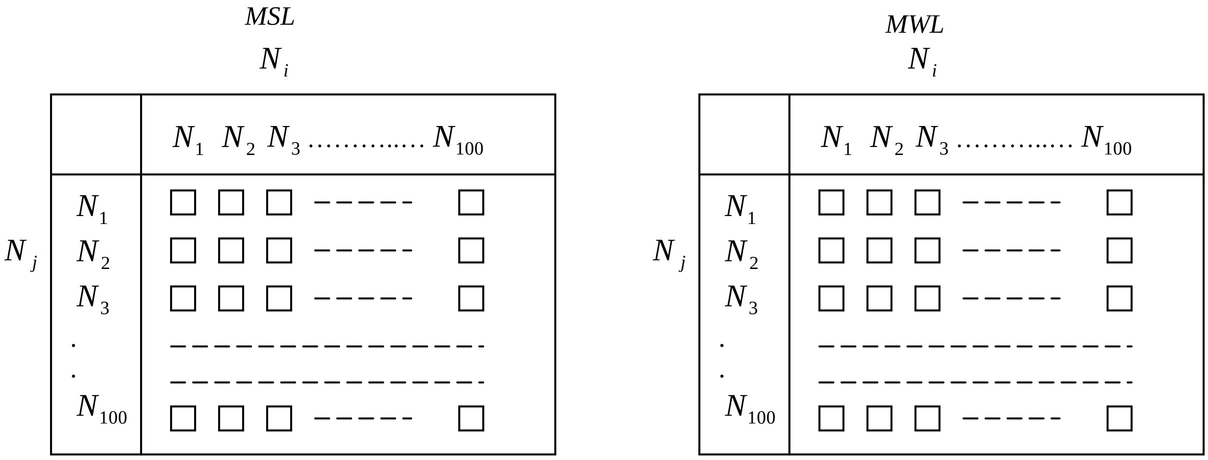

Fig. 2: Matrix representation of strong and weak links

Algorithm 2: Link establishment algorithm

Link_establishment(N_i, N_j *)*
For i=1 to n & j=1 to n ,i≠j
{
if $DIST \leq R_{TH(S)}$
MSL[i][j]=1;
else
MSL[i][j]=inf;

if $R_{TH(S)} < DIST \leq R_{TH(W)}$
WSL[i][j]=1;
else
WSL[i][j]=inf;
}

Such an algorithm establishes the strong links and weak links among node N_i and N_j. After establishment of links, a fully ad hoc network is deployed.

The total strong links are counted for each individual node in the network for a particular configuration. Further, we take one array A contains the node indices having strong links. Then searching the node $N_k, k \in n$ in the matrix A which has largest number of strong links. If *k=1*, then there is only one node $N_k, k \in n$ has maximum strong links in that configuration. If *k>1*, then there are a number of nodes having maximum strong links. The node(s) are considered the head in those ad hoc networks. These head nodes can collect the information from all other nodes and send it to the sink node, so that at a particular round of network deployment these nodes may active for larger period having the sufficient energy consideration without engaging the other nodes for trying to forwarding messages to the sink node.

A total of five rounds are considered for the network simulation. These rounds are based on the time. As round *m* is in time *t*, round *m+1* in time $t + \Delta t$ and round *m+2* in time $t + 2\Delta t$ so on. Now our job is to find out the difference of number of strong links in successive rounds should be incremental order so that we can find more head nodes. Therefore we take the following parameters

TSL_m : Total number of strong links in *m*th round.

TSL_{m+1} : Total number of strong links in *(m+1)*th round.

ΔSL : Difference of total number in strong links in *m*th and *(m+1)*th round.

So $\Delta SL = TSL_{m+1} - TSL_m$

Similarly

TWL_m : Total number of weak links in *m*th round.

TWL_{m+1} : Total number of weak links in *(m+1)*th round.

ΔWL : Difference of total number in weak links in *m*th and *(m+1)*th round.

So $\Delta WL = TWL_{m+1} - TWL_m$

For each round, if $\Delta SL > \Delta WL$, then the re-configuration of network is effective to establish more strong links.

IV. PROPOSED ALGORITHM

We adopt an algorithm to find the maximum number of strong links in comparison to weak links. As a result head nodes are selected and make an independent decision to forward the message to the sink node.

Particularly for two random nodes $N_i, N_j, i, j \in n, i \neq j$

1. *Find_DIST (* N_i, N_j *)*
2. Accept two threshold range values $R_{TH(S)}, R_{TH(w)}$ for establishment of strong link and weak links.
3. Establishing the links among the node through *Link_ establishment (* N_i, N_j *)*
4. Create two matrices A & B contains the indices of nodes having strong links and weak links.
5. Find the node $N_k, k \in n$ in matrix A having highest number of strong links.
6. If k=*1* then select N_k as the head node else if *k>1* then take sets of nodes N_{k1} , N_{k2}, N_{k3} …and randomly select one from set as head.
7. Find total number of strong links and weak links as *TSL* and *TWL*.
8. Compute the percentage of difference in the number of strong links and weak links in the successive rounds.

V. SIMULATION RESULTS AND DISCUSSIONS

MATLAB 7.0 was used for evaluation of the performance of our approach. The simulation study modeled a network of mobile nodes placed randomly with an area 700m×700m in which 100 nodes are placed. The mobility model is random-way point where nodes are randomly selected for positioning. In each simulation round, each node chooses the direction, speed and distance of move based on random distribution and also then computer its next position *p(x,y)* and time instant *t* of reaching the position. Each node has some physical properties, radio ranges of 125m and 175m for establishing strong links and weak links. A node computes its neighbour hood in each round thus generating the links.

Performance results

We have simulated 100 mobile nodes for wireless ad hoc networks with respect to random mobility. The model studies with respect to the following performance metrics

- Number of strong links and weak links
- Selection of head nodes
- Difference of number of strong links with respect to weak links in different rounds

The Figures 3 & 4 present the different configuration of the deployed network in the random model in different rounds. The Figure 5 describes more number of strong links achieved by the network in successive rounds. It is observed that the network becomes more stable in terms of more strong links establishment. The Figure 6 describes the more percentage of difference of strong links than the percentage of difference of weak links in several rounds.it is observed that in each re-configuration of network after time duration Δt , the possibility of establishment of strong links can be more which leads to maintain the stability of ad hoc network.

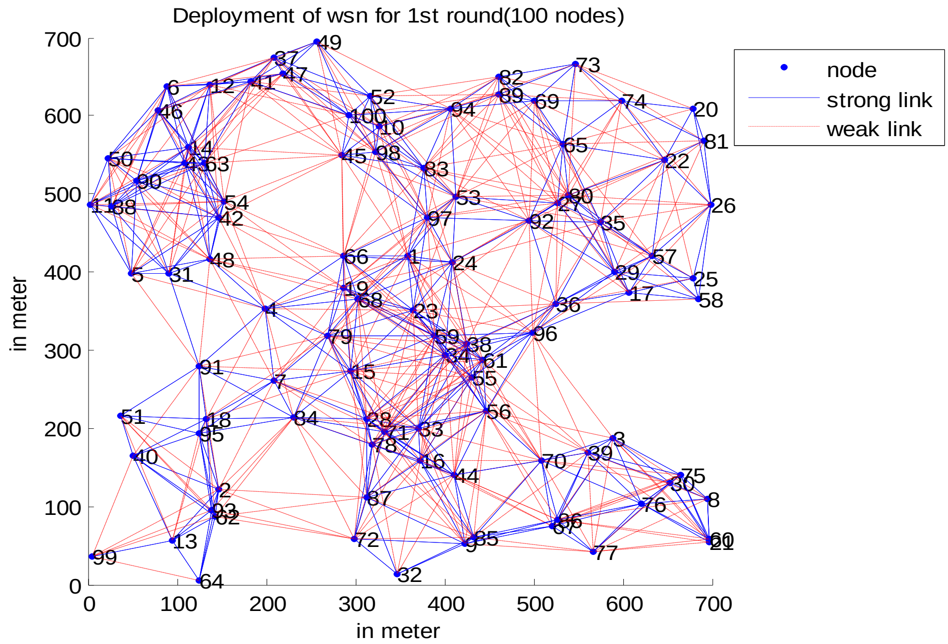

Figure-3: Network reconfiguration after first round

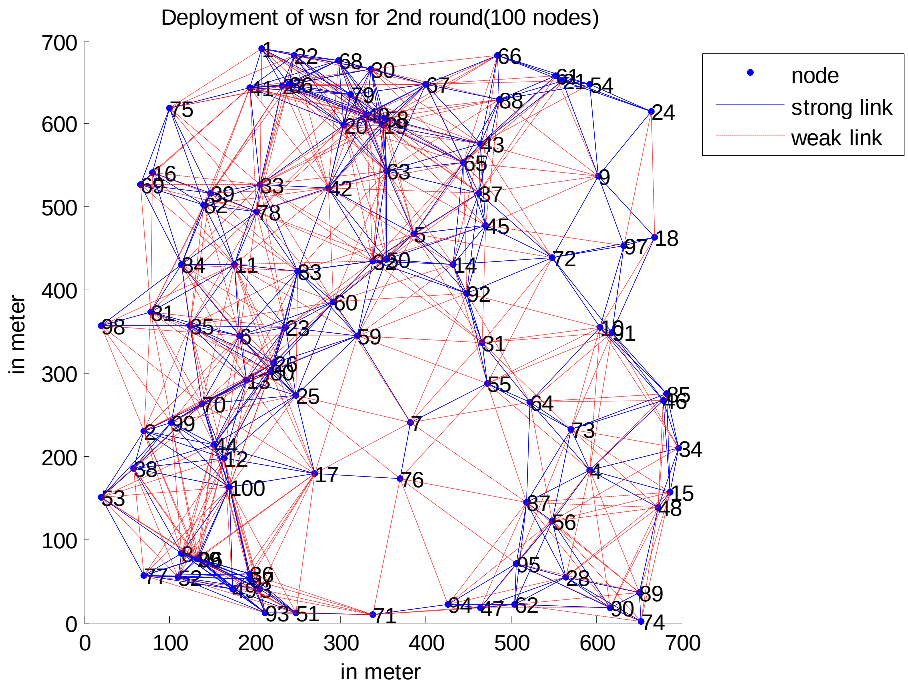

Figure-4: Network reconfiguration after second round

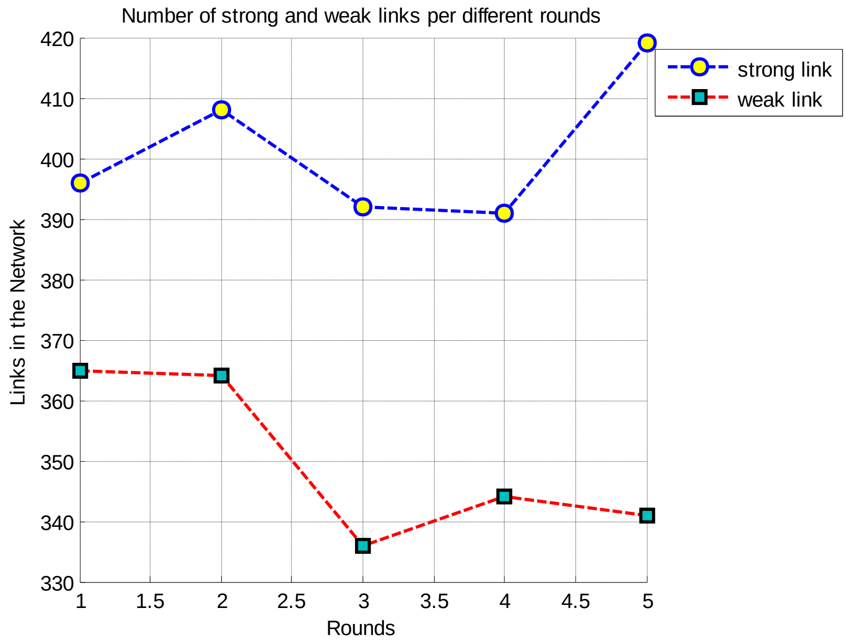

Figure-5: Strong and weak link characteristics at different rounds

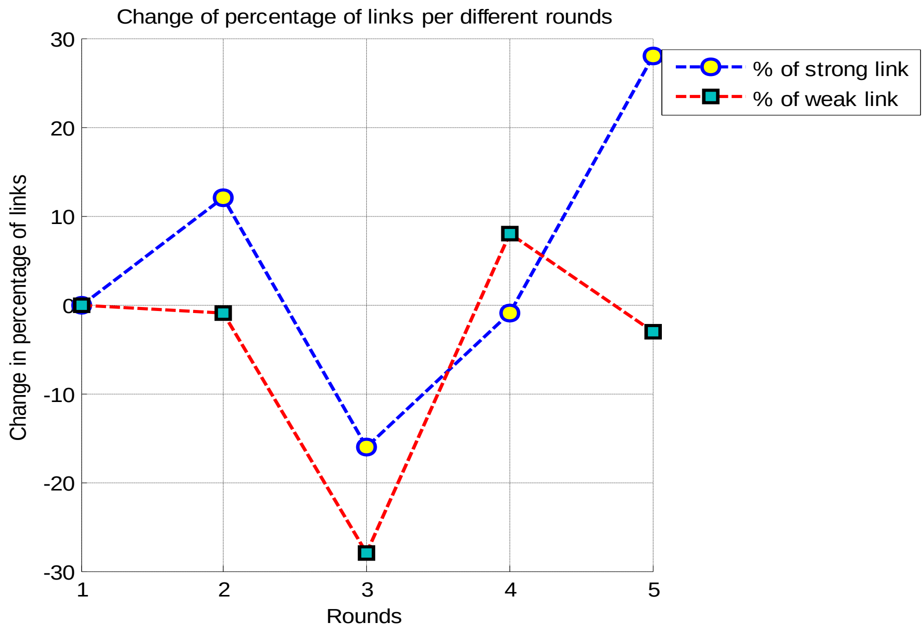

Figure-6: Percentage of link variations at different rounds

VI. CONCLUSION

In this paper, we have proposed a robust dynamic ad hoc wireless network with different configurations based on dynamic environment in which specific nodes acquire largest strong links in the network. Which is further selected as head nodes and these head nodes are responsible for sending the information collected from the network to the sink. In the future work we will consider the energy consumption of the node and cost of transmission of message to achieve the QOS of the network. Besides we try to involve our approach in real world.

REFERENCES

[1]. Paul Grace at-al-Dynamic reconfiguration in sensor middleware-midsens 06-Nov-27.
[2]. Sameer Tilak et-al-a taxonomy of wireless micro sensor network models-mobile computing and communication review, volume-6-number-2.
[3]. I.F. Akyildiz, W. Su*, Y. Sankarasubramaniam, E. Cayirci , A survey Wireless sensor networks ,Computer Networks 38 (2002) 393–422.
[4]. Raghavendra V. Kulkarni, Anna Förster, Member and Ganesh Kumar Venayagamoorthy- Computational Intelligence in Wireless Sensor Networks: A Survey-IEEE communications surveys & tutorials, vol. 13, no. 1, first quarter 2011
[5]. Biswanath Dey Sukumar Nandi. Distributed Location and Lifetime Biased Clustering for Large Scale Wireless Sensor Network[C]. In : Distributed Computing and Networking, 8th International Conference, ICDCN 2006. 534-54
[6]. Dayang Sun,Yanheng liu,Aimin wang, Bin Ge Research on Service-oriented Lifetime and Network Density in WSN In:IEEE 9th International Conference for Young Computer Scientists 2008, 439-444.
[7]. A. Woo, T. Tong, and D. Culler. Taming the underlying challenges of reliable multihop routing in sensor networks. In SenSys '03, 2003.
[8]. A.Woo and D. Culler. Evaluation of efficient link reliability estimators for low-power wireless networks. Technical Report UCB/CSD-03- 1270, EECS Department, University of California, Berkeley, 2003.
[9]. A. Becher, O. Landsiedel, G. Kunz, and K. Wehrle. Towards shortterm link quality estimation. In Hot Emnets, 2008.
[10]. Dayang Sun,Yanheng liu,Aimin wang, Bin Ge Research on Service-oriented Lifetime andNetwork Density in WSN In:IEEE 9th International Conference for Young Computer Scientists 2008, 439-444