ISSN: 2348 - 2117

International Journal of Engineering Technology and Computer Research (IJETCR)
Available Online at www.ijetcr.org
Index Copernicus Value 2016: 69.88
Volume 6; Issue 1; January-February 2018; Page No. 01-06

Power Consumption Reduction for Backbone Connectivity in Clustered Wireless Networks

Senior Programmer Hind Ibrahim Mohammed

Almuqdad Education College, Diyala University

E-mail: hindimohammed83@gmail.com

Abstract

The key challenge of wireless sensor networks researches is the energy consumption reduction to increase the lifetime of the nodes and improve the performance of the network. Furthermore, delivery of data to its destination is also an important issue that represents throughput of the network. This paper develops an algorithm to reduce the power consumption of the wireless nodes. The results reveals that more than 6% power saving can be achieved. This has obtained through reducing cluster head (CH)-transmissions of the backbone network nodes in a multi hop wireless sensor network with at least 95% connectivity probability.

Key words: *Wireless sensor networks, clustering, network topology.*

1. INTRODUCTION

IN the wireless networks, Clustering mechanism means allocating network's nodes into sets that called clusters. Hence each cluster has a single head (CH) which is collect and summarize the data flow from ordinary cluster's nodes and Gateway nodes (they aren't mandatory) which are shared between two or more clusters.[2]

Clustering technique provides us several benefits, lessening traffic volume of data flows and creating the CH-backbone in network by CHs and gateway nodes. Hence this will make network topology more simple and decrease Collision, interference and traffic congestion.[1][2] Furthermore, using Unequal Cluster-based Routing (UCR) protocol [3] of network's clustering technique for easing hotspot problem (known in multi hop networks). Hence, according to traffic flows of the network, choice cluster sizes.

On the other hand, normal nodes in clusters choose their CHs via CH candidacy announcements which performed by each node according to a probability scale which computed by individual nodes and it's considers the effect of hop distances to the sink on the relative traffic loads at different locations of network resulting for multihop forwarding.[3-5]

In clustering protocols for wireless sensor networks (WSNs), there are two issues. Firstly, if CH-to-CH transmission range is too long, it will ensure the successful delivery of network data to its destination, but this will require high transmission power and expensive modulation techniques. Secondly, if CH-CH transmission range is too short, it will drain low transmission power, but this option will cause fail in the data delivery and network partition [4-6]. Therefor,these two concepts make us rethink the fact that the range should be short enough to save energy and avoid high costs of data transmission and if the range is long enough to ensure that no split the network and achieve high data throughput.

In previous researches, algorithms are proposed to get the minimum transmission range with ensuring network connectivity are depended on the global information about node locations which is hard to succeed in WSNs. [6][7] Also, Local Minimum Spanning Tree (LMST) algorithm which give us less simplicity to avoid the mathematical complexity according to deployment density of network's nodes. [1][8], to ensure this. We used a new mathematic law to compute d_{Next} in [1] which will be reduced CH-to-CH transmission ranges and provide more conserving CH transmission power with remaining highest probability of end-to-end connectivity to the gateway.

2. New Computation of d_{Next} and power saving

We have followed the same approach in [1],using Algorithm 1 to compute the CH-to-CH communication range (R) by increasing R until obtaining at least 95% end-to-end connectivity probability (prop) for a CH node located at a distance from the gateway. Hence R0 is the initial value of R and ΔR is the range increment.

Algorithm 1, algorithm to compute *R*
1: $R \leftarrow R0$;
2: [*prop*] $\leftarrow$ *connect*(λ, d, R);
3: while $prob < M$ do
4: $R \leftarrow R+\Delta R$;
5: [*prop*] $\leftarrow$ *connect*(λ, d, R);
6: end while
7: return *R*

Where the procedure connect returns prob. which is obtained it by using algorithm 2.Hence, the probability of end-to-end connectivity to the gateway for a given CH node density λ, and value of CH-to-CH communication range R. provides the procedure connect.[1]

Algorithm 2, Procedure connect (λ, d, R)
1:prob$\leftarrow$1;
2:K $\leftarrow$0;
3:$\bar{r} \leftarrow E[r] = \frac{\int_0^R 2\pi r^2 \lambda\, e^{-\lambda\pi(R^2-r^2)}}{1-e^{-\lambda\pi R^2}}$;
4:while d > R do
5: $K \leftarrow K + 1$;
6:$\alpha \leftarrow 2\sin^{-1}(R/2d)$;
7:$\beta \leftarrow \frac{(\pi-3\alpha)}{2}$;
8: $C \leftarrow \int_0^\beta e^{-2\lambda\left[\frac{\theta\,\bar{r}^2-\frac{\bar{r}^2}{2}\sin(2\theta)}{2}\right]} d\theta$;
9:$\bar{\theta} \leftarrow \frac{1}{C}\int_0^\beta \theta\, e^{-2\lambda\left[\frac{\theta\,\bar{r}^2-\frac{\bar{r}^2}{2}\sin(2\theta)}{2}\right]} d\theta$;
10:$d_{Next} \approx d - \bar{r}\cos\bar{\theta}$;
11: $d \leftarrow d_{Next}$;

$s \leftarrow (2d + R)/2$;

$a \leftarrow \sqrt{s(s-d)^2(s-R)}$;

$Area_1 \leftarrow d^2\alpha/2 - a$;

$Area_2 = \frac{R^2\beta}{2}$;

$Area\ (R_{Next}) = 2\ (Area_1 + Area_2)$;

if K == 1 then

prob$\leftarrow (1 - e^{-\lambda Area\ (R_{Next})})$prob ;

else

$(R_{new}) \leftarrow ((2K-3)\bar{r} + 2R)\bar{r}\bar{\theta}$;

prob.$\leftarrow (1 - e^{-\lambda Area\ (R_{new})})$prob ;

end if

end while

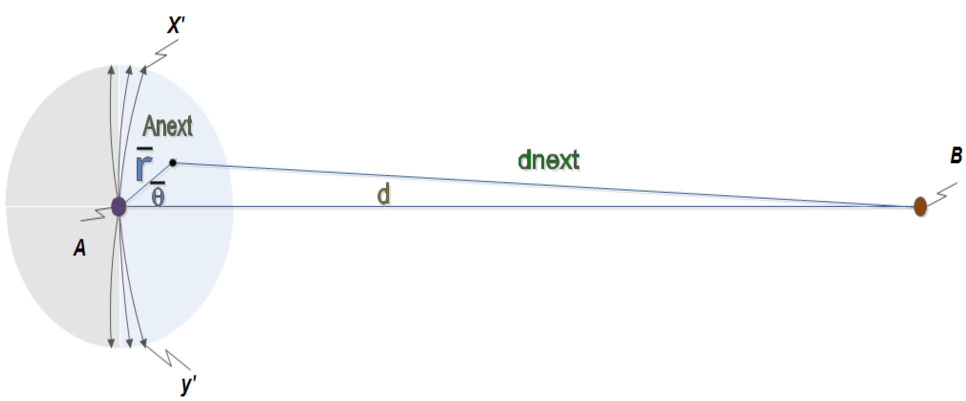
if d >0 then

$K \leftarrow K + 1$;

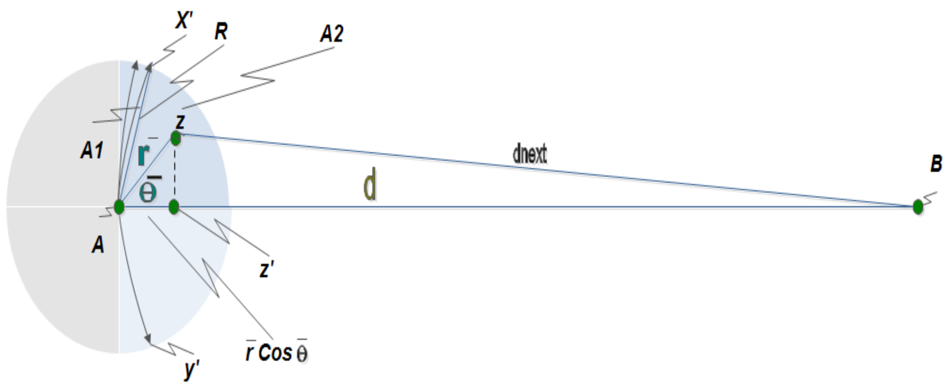
end if

return prob.

Also, for an X×X network.[1] Hence, X = 1000 m and the best estimation is obtained for choosing the CH that is X/2 away from the gateway for all density values.[1]



(a)A_{next} and new distance d_{Next} (previous formula) [1]



(b) A_{next} and new distance d_{Next} (new law)

Fig. 1: Locating the next hop node towards the gateway.

3. Computation of d_{Next} (previous formula)

In [1], (d_{Next}) is computed as shown in figure (1a), by using the relation in line 10 of algorithm 2.

$$d_{Next} \approx \sqrt{\bar{r}^2 + d^2 - 2d\bar{r}\cos\bar{\theta}} \qquad (1)$$

4. Computation of d_{Next} (new Formula)

As shown in figure 1b, the idea is that the component of $\bar{r}$ on the straight line AB is ($\bar{r}\cos\bar{\theta}$), therefore we can also approximate d_{Next} as shown below.

$$d_{Next} \approx d - \bar{r}\cos\bar{\theta} \qquad (2)$$

Where $\bar{r}$ is the expected value of the minimum radial distance,$0 < r \leq R$and $\bar{\theta}$ is the average angular deviation,$0 \leq \theta \leq \beta$. Hence, both $\bar{r}$ and $\bar{\theta}$ are computed in [1] line 3 and line 9 respectively of algorithm 2, and then we can find power transmit by using this law.[2]

$$P_{AB} = R^2 \qquad (3)$$

Where P_{AB} the minimum transmission power is required from node A to a getaway B and R is the transmission range in (m), and therefore we can found the Power saving percentage for minimum transmission ranges from below law.

$$\text{Power saving } \% = \left(1 - \frac{P_{New}}{P_{Old}}\right) \times 100\% \qquad (4)$$

Where P_{Old} is the power transmit with using previous law of d_{Next} and P_{New} is the power transmit with using new law of d_{Next} .

5. CONCLUSION AND PERFORMANCE EVALUATION

With a guarantee to get at least 95% end-to-end probability connectivity to find minimum range R for various node densities$\delta = 3 * 10^{-3}, 4 * 10^{-3}, 5 * 10^{-3} and\ 6 * 10^{-3}$and the CH selection probability is $P_1 = 0.1$ and also setting$R_o = 10\ mand\ \Delta R = 1\ m$, this shown in Figure 2,which refer to the Probability of connectivity versus transmission range. This performance results of running algorithms 1 and 2 with previous d_{Next} 's law [1]. Hence, obtaining minimum transmission range R with highest node density $(6 * 10^{-3})$. While figure 3, shown our performance results with using new d_{Next} 's lawin algorithm 2 that give us lower transmission ranges at the same node density, causing more power saving at data transmissions as shown in table 1.

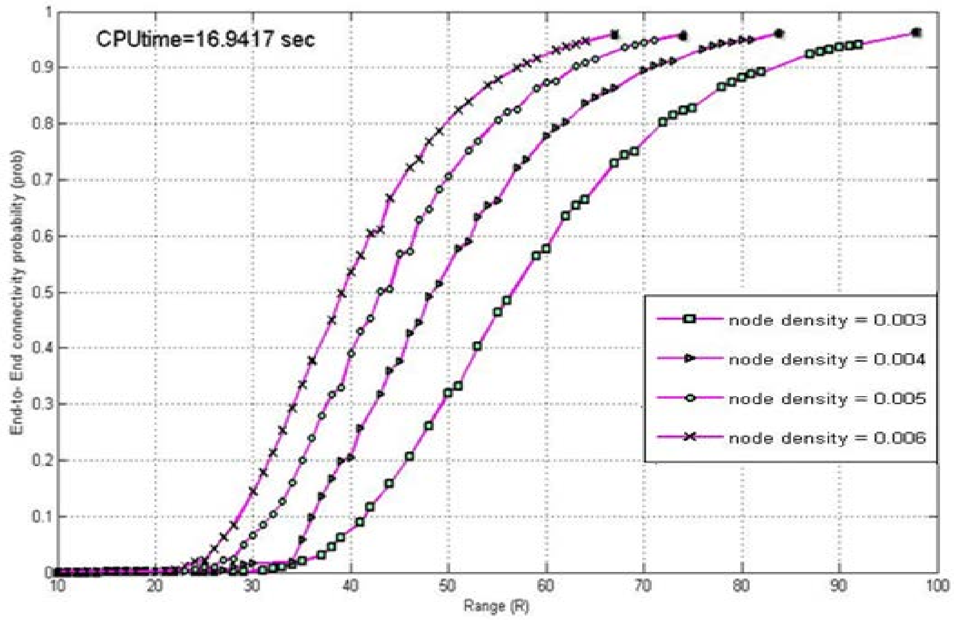


Fig. 2: Connectivity probability versus R for the approach of [1] with different values of node density

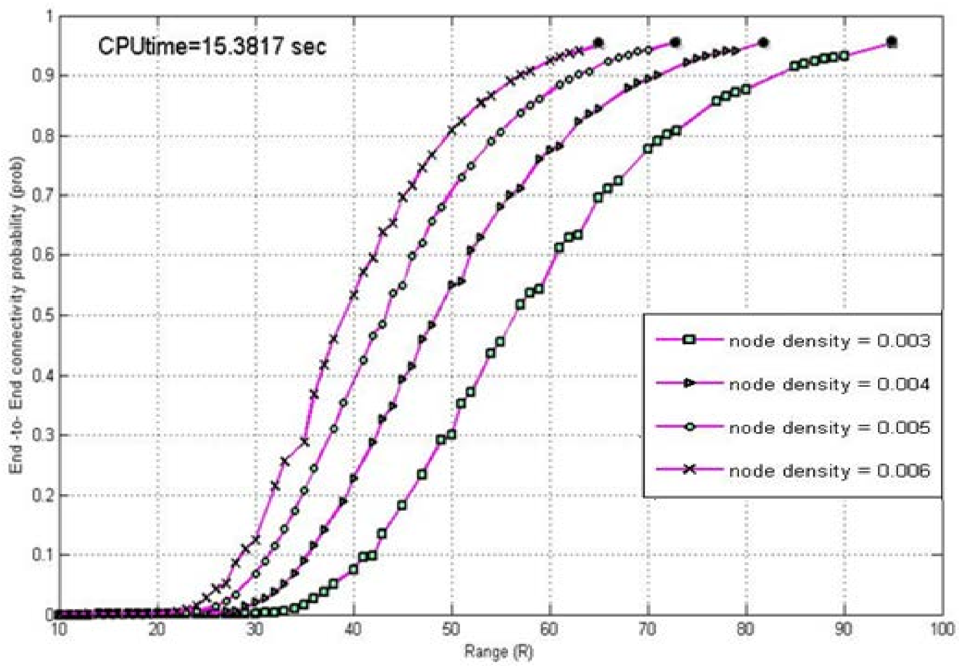


Fig. 3: Connectivity probability versus R for a new dNext's law with different values of node density σ

Table 1: Power saving %Comparison for 95%Connectivity Prob.

Node density	Range R with for approach[1](m)	Range R for our approach (m)	Power saving%
0.003	98	95	6.03
0.004	84	82	4.71
0.005	74	73	2.70
0.006	67	65	5.90

REFERENCES

1. SerdarVural, PirabakaranNavaratnam, and Rahim Tafazolli ”Transmission Range Assignment for Backbone Connectivity in Clustered Wireless Networks”IEEE Trans. Wireless Commun.,vol.. 2, NO. 1, Feb. 2013.
2. AbolfazlAkbari, NedaBeikmahdavi”Coverage and Clustering Guarded for Wireless Sensor Network” Int. J Latest Trends Computing Vol-2 No 3 September, 2011.
3. G. Chen, C. Li, M. Ye, and J. Wu, “An unequal cluster-based routing protocol in wireless sensor networks,” Springer Wireless Networks, 2007.
4. D. Wei, Y. Jin, S. Vural, and R. Tafazolli, “An energy-efficient clusteringsolution for wireless sensor networks,” IEEE Trans. Wireless Commun.,vol. 10, no. 11, Nov. 2011.
5. O. Younis and S. Fahmy, “HEED: a hybrid, energy-efficient, distributedclustering approach for ad hoc sensor networks,” IEEE Trans. MobileComput., vol. 3, no. 9, pp. 366–379, Dec. 2004.
6. Q. Dai and J. Wu, “Computation of minimal uniform transmission rangein ad hoc wireless networks,” Springer J. Cluster Comput., vol. 8, no.2–3, pp. 127–133, 2005.
7. R.Ramanathan and R. Hain, “Topology control of multihopwirelessnetworks using transmit power adjustment,” in 2000 IEEE Infocom.
8. F. J. O. Mart´ınez, I. Stojmenovi´c, F. G. Nocetti, and J. S. Gonz´alez,“Finding minimum transmission radii for preserving connectivity andconstructing minimal spanning trees in ad hoc and sensor networks,”Elsevier J. Parallel and Distributed Comput., 2005.