# COMPARATIVE ANALYSIS OF ROUTE INFORMATION BASED ENHANCED DIVIDE AND RULE STRATEGY IN WSNS

Rajeev Kumar Harsukhpreet Singh and Anurag Sharma

Department of Electronics and Communication Engineering, CTITR, Maqsudan, Jalandhar

### *ABSTRACT*

*In wireless sensor network, routing data efficiently to the base station is a big issue and for this purpose, a number of routing algorithms are invented by researchers. Clustering plays a very important role in the design and as well as development of wireless sensor networks for well distribution of network and also to route data efficiently. In this paper, we had done the enhancement of divide and rule strategy that is basically route information protocol based upon static clustering and dynamic cluster head selection. Simulation results show that our technique outperforms DR, LEACH, and AODV on the basis of packet loss, delay, and throughput.*

### *INDEX TERMS*

**Routing protocols, clustering, Coverage hole and energy hole.**

## 1. INTRODUCTION

WSNs consist of a number of sensor nodes that have the capability of computation and can communicate with each other to send data efficiently to the base station (BS) wirelessly. Also these sensor nodes are having limited energy source. [1]. So routing data efficiently to the BS is one of the major issues in WSNs. For this purpose many routing techniques, algorithms and protocols have been invented [2][16][17]. Clustering is one of them it saves the energy of the sensor nodes to a large extent by grouping them. A group of sensor nodes is termed as a cluster and each cluster is having a cluster head (CH). A CH is chosen on the basis of many different parameters like its proximity to all the other nodes of the cluster, its residual energy, distance from the BS, and many more [3]. In a cluster, each and every node senses the data. But they pass it their CH only, unlike in normal routing techniques where information is passed to all the other nodes. Hence, it leads to the savage of the energy of the sensor nodes. The CH then passes the data received from the nodes in its cluster to the BS [23] [30].There are number of protocols suggested by researchers that divide the network area to remove the issue of coverage hole [32]. In our research, proposed protocols network division and working is explained in detail in following sections.

Initially the network is divided into n number of concentric squares with base station at the center of the network. The value of n depends upon network area and node density of the network. For understanding the proposed strategy, we use three concentric squares named inner square (*Is*), middle square (*Ms*) and outer square (*Os*) [33][32]. Using the co-ordinates of base station $(x_1, y_1)$as reference point and adding distance d to these co-ordinates to make equations.

$$\boldsymbol{T_r^{Is}(x_2, y_2) = (x_1 + d, y_1 + d)} \quad (1)$$
$$\boldsymbol{B_r^{Is}(x_2, y_2) = (x_1 + d, y_1 - d)} \quad (2)$$
$$\boldsymbol{T_l^{Is}(x_2, y_2) = (x_1 - d, y_1 + d)} \quad (3)$$
$$\boldsymbol{B_r^{Is}(x_2, y_2) = (x_1 - d, y_1 - d)} \quad (4)$$

Where

$T_r^{Is}$ = Top right corner of inner square
$B_r^{Is}$ = Bottom right corner of inner square
$T_l^{Is}$ = Top left corner of inner square
$B_r^{Is}$ = Bottom left corner of inner square

Above written equations are for inner square and for middle and outer square d is multiplied by 2 and 3 respectively. Than these squares further divided into subparts. To further divide the network we take top right and bottom right corners of inner square as reference point and by adding d in x-coordinate of the upper right corner $(x_3 + d, y_3)$ and y-coordinates of bottom right corner $(x_3, y_3 + d)$, we get new region S1. Similarly new regions are created using co-ordinates of concentric squares [3].

## 2. CLUSTER HEAD SELECTION

Initially, the cluster head is selected as the node with smaller distance from cluster head. In the next rounds as multihoping is done within the cluster, energy of the node dissipated differently so node with the higher energy is selected as cluster head. There is no cluster head in inner square

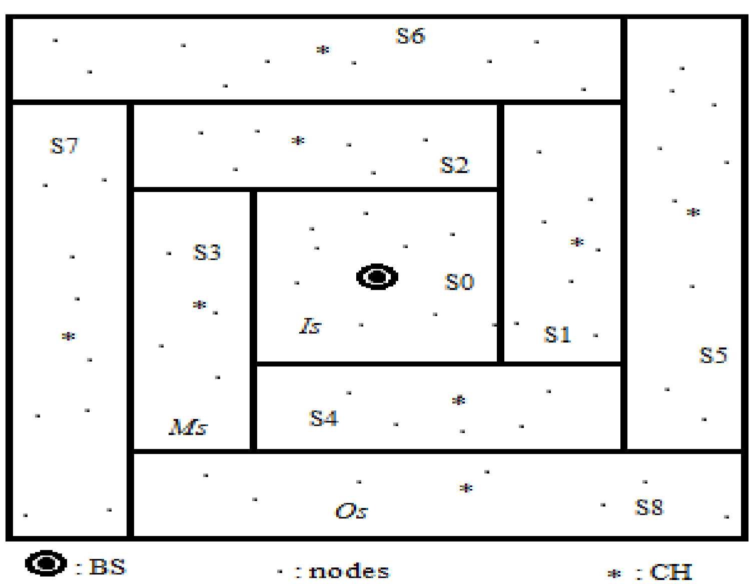


Figure 1: block diagram

## 3. PROTOCOL WORKING

DR strategy lacks systems efficiency as nodes of corner region because of large communication distance between them and cluster heads exhaust their energy rapidly and hence to overcome this issue we proposed improved divide and rule strategy. In proposed strategy, we use intra-cluster multihoping that is corner region nodes send the aggregated data to the node close to the base station as its next hop instead of sending data directly to the cluster head. Than this node send its own aggregated data and data from the previous node to the cluster head. In the next step, after data aggregation from all nodes cluster heads of outer region send data to the cluster heads of middle square as their next hop and then middle regions cluster head send data to the base station.

## 4. RESULTS AND DISCUSSIONS

We analyze the results using network simulator 2.35 and check improved divide and rule strategy in varying network sizes as well as node density and simulation time. Results depict that improved divide and rule strategy proves better than the other protocols in terms of delay, packet loss and throughput.

Delay: The time required by packet to reach destination from the source is known as delay. Delay of improved divide and rule strategy is better than the other protocols as corner region nodes alive for longer time. According to figure 1a, in 25*25 network area, improved divide and rule strategy's delay is 10% less than DR, 17% less than LEACH and 31% less than AODV. In 50*50 network area, improved divide and rule strategy's delay is 11% less than DR, 16% less than LEACH and 27% less than AODV. In 75*75 network area, improved divide and rule strategy's delay is 2% less than DR as well as LEACH and 10% less than AODV. In 100*100 network area, improved divide and rule strategy's delay is 7% less than DR, 3.7% less than LEACH and 15% less than AODV. Thus in 100*100 network area, propagation delay of improved divide and rule strategy is less than DR, LEACH and AODV routing protocol.

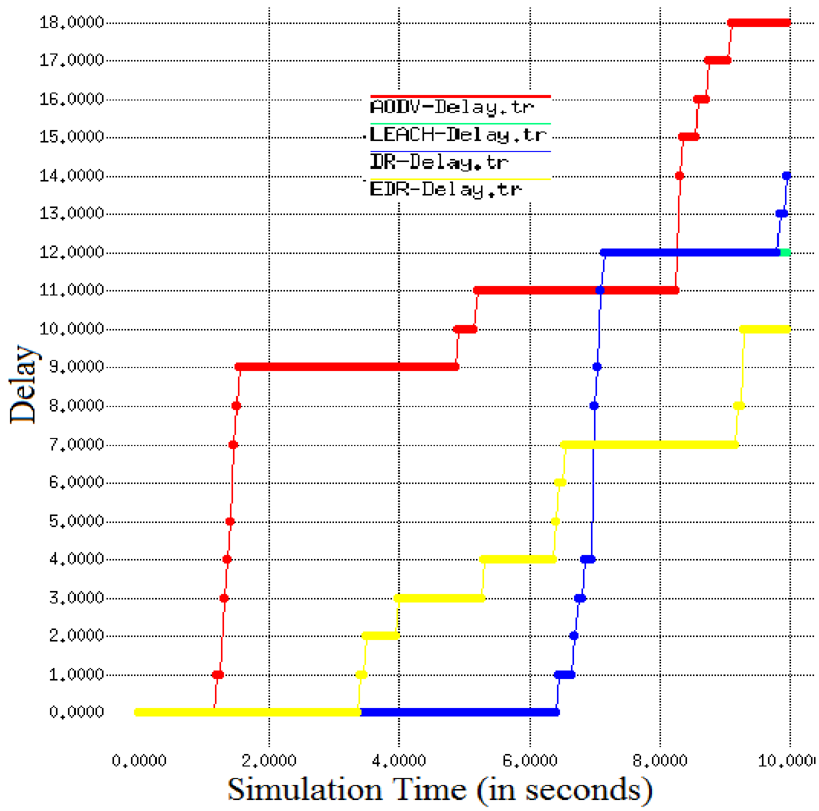


Figure 1a: Delay (100*100 area)

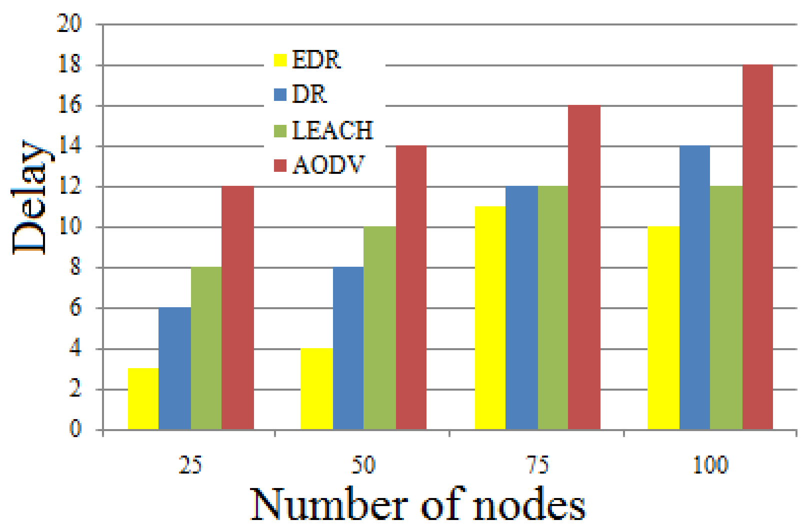


Figure 1b: Delay (node density)

Packet loss: The number of packets that not reaches the BS during transmission is known as packet loss. According to figure 2a, packet loss of improved divide and rule strategy's results better than LEACH and AODV for smaller or even larger networks. In 25*25 network area, improved divide and rule strategy's packet loss is 9% less than DR, 21% less than LEACH and 35% less than AODV. In 50*50 network area, improved divide and rule strategy's packet loss is 5% less than DR, 18% less than LEACH and 44% less than AODV. In 75*75 network area, improved divide and rule strategy's packet loss is 5% less than DR, 19% less than LEACH and 40% less than AODV. In 100*100 network area, improved divide and rule strategy's packet loss is 8% less than DR, 13% less than LEACH and 49% less than AODV. Figure 2b shows the results for 100*100 network area with respect to simulation time and packet loss of improved divide and rule strategy is less than rest of the protocols.

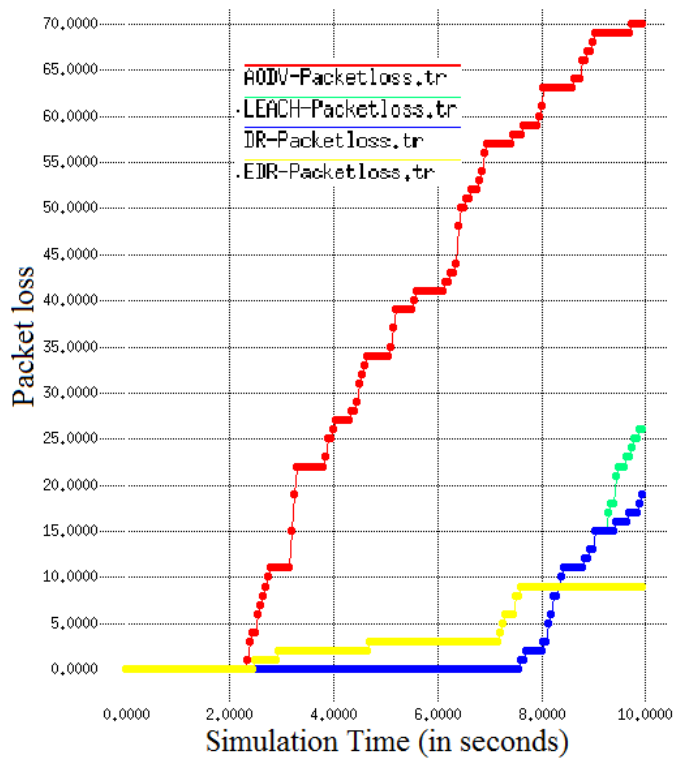


Figure 2a: Packet loss (100*100 area)

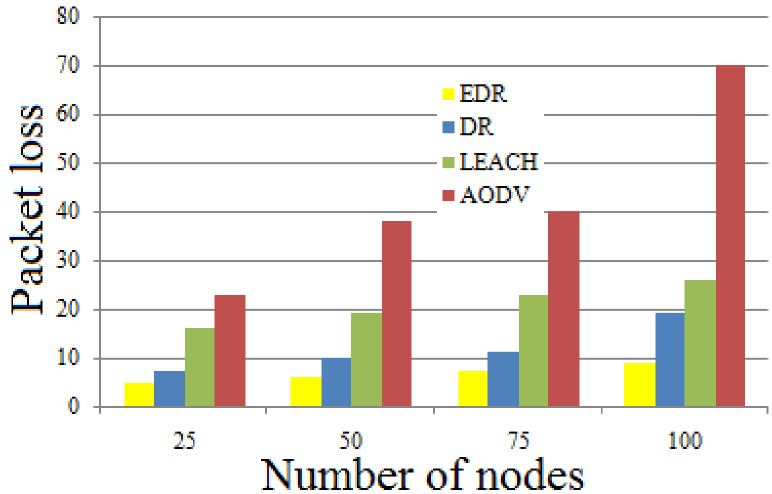


Figure 2b: Packet loss (node density)

Throughput: The number of packets received at the base station per unit time is known as throughput. According to figure 3a, throughput of improved divide and rule strategy's proves better and is increase in smaller as well as large networks. In 25*25 network area, improved divide and rule strategy's throughput is 0.2% more than DR, 1% LEACH and 14% more than AODV. In 50*50 network area, improved divide and rule strategy's throughput is 0.3% more than DR, 6% more than LEACH and 16% more than AODV. In 75*75 network area, improved divide and rule strategy's throughput is 2% more than DR, 5% more than LEACH and 13% more than AODV. In 100*100 network area, improved divide and rule strategy's throughput is 1% more than DR, 3% more than LEACH and 15% more than AODV. Figure 3b shows the results respective to the simulation time, and improved divide and rule strategy proves better than DR, LEACH and AODV.

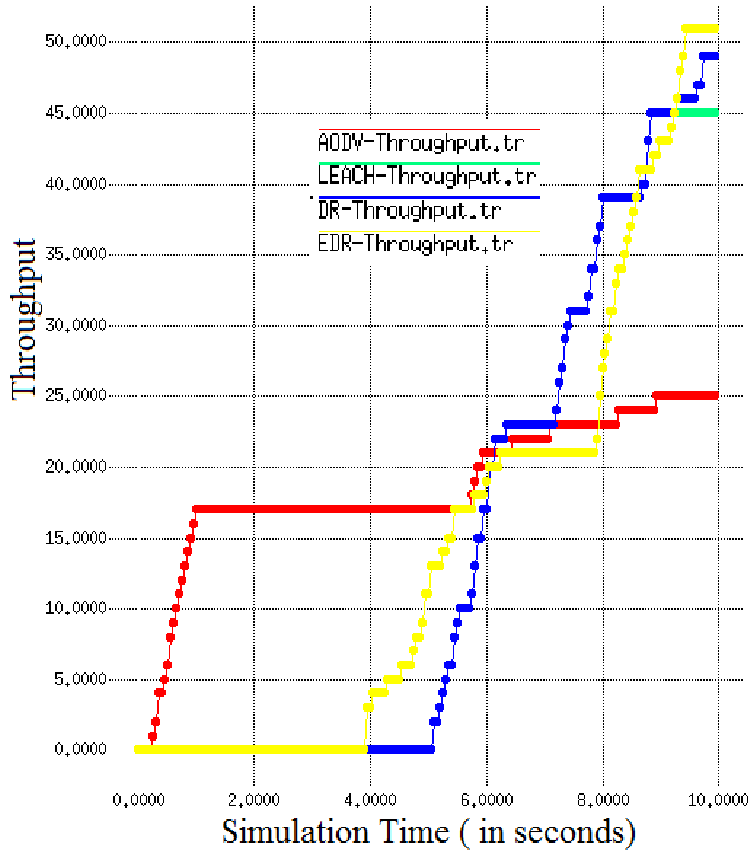


Figure 3a: Throughput (100*100 area)

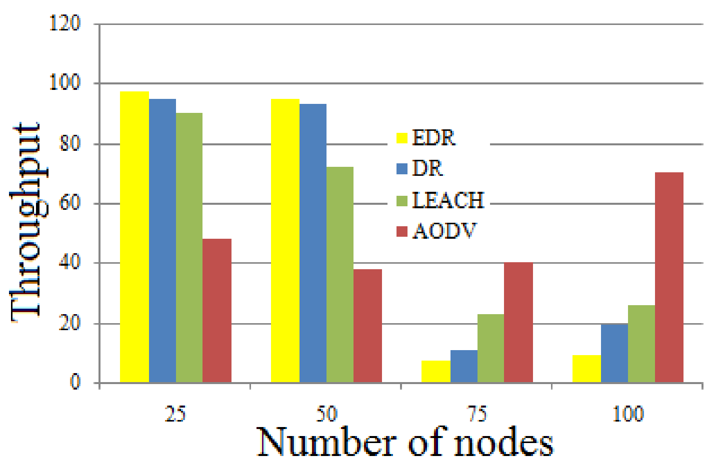


Figure 3b: Throughput (node density)

## 5. CONCLUSION

In this paper we introduce improved divide and rule strategy that is based upon static clustering and energy based cluster head selection. As number of cluster heads remains constant throughout the network load id equally distributed among the nodes. In this strategy we use multihoping within the clusters as well as outside the cluster to save energy and increase efficiency of the network. We compare our technique with DR strategy, LEACH and AODV using network simulator in terms of delay, packet loss and throughput. Results show our technique performs better than rest of the protocols.

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