

# Divide and Rule Scheme for Energy Efficient Routing in WSNs

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# Motivation

## Objectives

- Stability period enhancement
- Instability period reduction
- Network lifetime enhancement
- Throughput maximization
- Delay minimization

# Motivation...

Problems in existing work

- Non uniform distribution of load
- Coverage hole formation
- Optimum number of CHs selection
- Localization

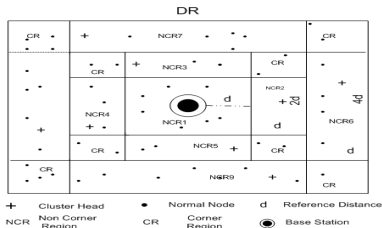
## Proposed Scheme

- Formation of regions
- CH selection
- Energy consumption model

# Proposed scheme...

## Formation of regions

- We divide entire network area into small logical regions, such that communication distance is reduced
- In first step network area is divided into  $n$  equal distant concentric squares
- In second step we divide the area between two concentric squares into equal area quadrilaterals, as Corner Regions (CR) and Non Corner Regions (NCR)



# CH selection

## Primary level CH selection

- Nodes whose co-ordinates lie in  $I_s$  are nearer to BS therefore, they send data directly to BS
- As clusters are static, therefore one CH is selected in each NCR
- Mid point of each NCR is considered as reference point for selection of CH in that region
- Nearest node from central reference point is selected as CH
- Next nearest node from the reference point is selected as CH for next round and so on

# CH selection...

## Secondary level CH selection

- CHs in OS regions, send data to CHs of exactly one level above adjacent regions CH
- These CHs are also known as secondary level CHs
- Secondary level CHs aggregate their own cluster nodes data and, data of the primary level CH then, transmit data to BS.

# Proposed scheme...

## Protocol operation

- In setup phase BS divides the network into small regions, on the basis of their co-ordinates
- $I_s$  nodes send data directly to BS
- In each region one CH is selected per round
- CHs of  $O_s$  regions, select front neighboring CHs of  $M_s$  regions as their next hop CH
- Nodes of CR select, BS or neighbouring CHs as their CH, based on minimum distance



## Proposed scheme...

### Protocol operation...

- If a tie occurs, for a node of CR, in selection of CH from its neighbouring regions than, it is resolved by selecting the CH with greater residual energy
- In steady state phase each node send its data to CH in its allocated time slot
- Primary level CHs send aggregated data to their respective secondary level CHs
- Secondary level CHs then, aggregate all collected data and forward it to BS

## Energy consumption model

- Nodes of  $I_s$  consume transmission energy only
- CHs of  $M_s$  consume transmission, aggregation and reception energies
- Non CH nodes of  $M_s$  consume transmission energy
- CHs of  $O_s$  consume transmission, aggregation and reception energies
- Non CH nodes of  $O_s$  consume transmission energy

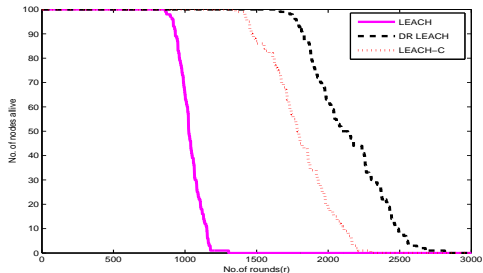
# Performance Evaluation

## Network model

- Number of nodes=100
- Network area of  $100m^2$
- Initial energy of each node is  $0.5J$
- Interference effects in wireless channel are ignored
- We used MATLAB simulator
- Radio parameters used are,  
 $E_{elec} = E_{tx} = E_{rx} = 50nJ/bit$   
 $E_{DA} = 5nJ/bit/signal$   
 $E_{fs} = 10pJ/bit/m^2$   
 $E_{mp} = 0.0013pJ/bit/m^4$

# Performance Evaluation...

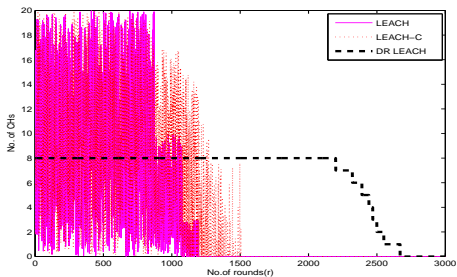
## Stability period and Network lifetime



- DR clustering approach minimizes communication distances
- Distant nodes of CRs are not enforced to associate with CH
- Nodes of CRs may associate either with minimum distant CH or minimum distant BS

# Performance Evaluation...

Number of CHs per round



- Near to optimum number is achieved and load is balanced throughout the network operation time, a step towards efficient energy utilization

## Conclusion

- DR scheme uses a hybrid approach of static clustering and dynamic CH selection
- Characteristics of achieving optimum number of CHs in each round and hierarchical inter CHs communication of our technique provided better results
- Large network area and greater number of nodes decrease DR efficiency in terms of energy consumption
- Another drawback arises when Cluster members associate with CH of its own region even if CH of other region is at a shorter distance