Density controlled-Divide and Rule Scheme for Energy Efficient Routing in WSNs

Prepared by Ashfaq Ahmad (BS Telecom Engg Student)

A. Ahmad\textsuperscript{1}, K. Latif\textsuperscript{1}, N. Javaid\textsuperscript{1}, Z. A. Khan\textsuperscript{2}, U. Qasim\textsuperscript{3}

\textsuperscript{1}COMSATS Institute of IT, Islamabad, Pakistan.
\textsuperscript{2}Faculty of Engineering, Dalhousie University, Halifax, Canada.
\textsuperscript{3}University of Alberta, Alberta, Canada.

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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
- Energy hole formation
Proposed Scheme

- Cluster formation
- Energy consumption in different segments
- CH selection and energy consumption of CH
Proposed scheme...

Cluster formation

- Static clustering technique is used
- Nodes are uniformly distributed in the network but randomly distributed in the clusters
- BS segmentizes network area into segments called clusters
- Segmentation reduces the communication distance
Proposed scheme...

Energy consumption in different segments

- Energy consumption in $I_s$ segment

$$E_{I_s}^{T_x} = 4\rho d^2 T_{Energy} \quad (1)$$

- Energy consumption in $M_s$ segments

$$E_{M_s/Seg}^{T_x} = 4(3\rho d^2 - 1) T_{Energy} \quad (2)$$

- Energy consumption in $O_s$ segments

$$E_{O_s/Seg}^{T_x} = 4(3\rho d^2 - 1) T_{Energy} \quad (3)$$

where, $\rho =$ node density
Proposed scheme...

CH selection

- New CH is selected in each round, in each segment
- Node with minimum distance from central reference point is selected first, then second least, third least and so on
- Number of CHs in each round remain $x$ throughout network operation
- In order to reduce communication distance multi-hop communication strategy is adopted in inter-cluster communication
Proposed scheme...

Energy consumption of CH

- $O_s$ CHs transmit their cluster members data to CHs of $M_s$. Thus, they consume transmit energy only
- $M_s$ CHs aggregate data from $O_s$ CHs with their own and transmit it to BS. So, they consume receive, aggregate and transmit energies
Performance Evaluation

Performance metrics and Simulator used

- Stability period
- Network lifetime
- Throughput
- Optimum number of CHs

MATLAB R2011
Performance Evaluation...
Assumptions and Radio parameters

- Nodes are equipped with initial energy of 0.5J
- Network field, 100m²
- Total number of nodes are 100

\[ E_{elec} = E_{tx} = E_{rx} = 50nJ/\text{bit} \]
\[ E_{DA} = 5nJ/\text{bit/signal} \]
\[ E_{fs} = 10pJ/\text{bit/m}^2 \]
\[ E_{mp} = 0.0013pJ/\text{bit/m}^4 \]
Performance evaluation...
Stability period and Network lifetime

- DDR clustering approach minimizes communication distances and optimum number of CHs remain same in each round which, ultimately enhances stability period of the network
- Balanced energy utilization and avoidance of coverage hole enhances the network lifetime
Performance evaluation...

Throughput

- Enhanced stability period and network lifetime, increase DDR’s throughput
Conclusion

- DDR is based on static clustering and optimum number of CH selection in each round
- Segmentation process helps to reduce communication distance between node and CH, and between CH and BS
- Multi-hop communication in inter-cluster further reduces communication distance
- We have tried to overcome the problem of coverage hole and energy hole through density controlled uniform distribution of nodes in different segments of network
- Optimum number of CHs in each round helps to achieve balanced load distribution