A Hierarchical Clustering Method in Wireless Ad Hoc Sensor Networks

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Presented by Chia-Yi Lien
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Outline

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Introduction

- The focus is designing a hierarchical clustering algorithm to find an interconnected set of non-overlapping clusters covering the entire device population with energy efficiency.
Related work

- LEACH (Low Energy Adaptive Clustering Hierarchy)
  - Regard the number of times to be selected as cluster head as the metric for head selection
The Potential of a Device to Serve as a Cluster Head (PDSC)

- Considering a group of $N$ devices, a measure of the potential of device $i$ ($i=1,2,\ldots,N$) to serve as a cluster head as:

$$PDSC_i = k_i \sum_{j=1}^{N} e^{-\frac{\Delta E|d_{i,j}|}{mT r^2}} \quad m = 1,2,3,\ldots$$

, where

$$k_i = \begin{cases} 1, & \text{Residual Energy} \geq E_{TH} \\ 0, & \text{Otherwise} \end{cases}$$
The Hierarchical Clustering Algorithm (1/4)

Fig 3. Comparing the PDSC values, devices decide to associate to cluster heads.
a. After comparing the PDSC values, devices send CMAPs to their cluster heads.
b. Three clusters are constructed.

cluster-head-application packet (CHAP)
cluster-member-association packet (CMAP)
The Hierarchical Clustering Algorithm (2/4)

Fig. 4. Comparing PDSC values, clusterheads choose a clusterhead as the PNC.

a: After comparing PDSC values in PSPs, cluster heads send PVPs to the clusterhead with the maximum PDSC value.

b: The PNC is selected.

PNC-Selection packets (PSPs)
PNC-Voting packet (PVP)
The Hierarchical Clustering Algorithm (3/4)

Cluster-head-application packet (CHAP)
Cluster-member-association packet (CMAP)
The Hierarchical Clustering Algorithm (4/4)

PNC-Selection packets (PSPs)
PNC-Voting packet (PVP)
Simulation (1/2)

Fig. 6. Simulation results: node life time.
Simulation (2/2)

Fig. 7 Simulation results: throughput
Conclusions

- Through computing and comparing the PDSC in a distributed manner, devices with more capability are chosen for cluster heads and PNC.
- The simulation results validate that the proposed clustering algorithm prolongs lifetime, and improves throughput.