A Hierarchical Clustering Method in Wireless Ad Hoc Sensor Networks

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Outline

- Introduction
- Related work
- The Hierarchical Clustering Algorithm
- Simulation
- Conclusions

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,…,N) to serve as a cluster head as:
  - $$PDSC_i = k_i \sum_{j=1}^{N} e^{-\frac{\Delta E}{mT}\frac{\|d_{i,j}\|}{r^2}} \qquad m = 1, 2, 3, \cdots$$

  ,where $$k_i = \begin{cases} 1, & \text{Residual Energy} \geq E_{TH} \\ 0, & \text{Otherwise} \end{cases}$$

The Hierarchical Clustering Algorithm (1/4)

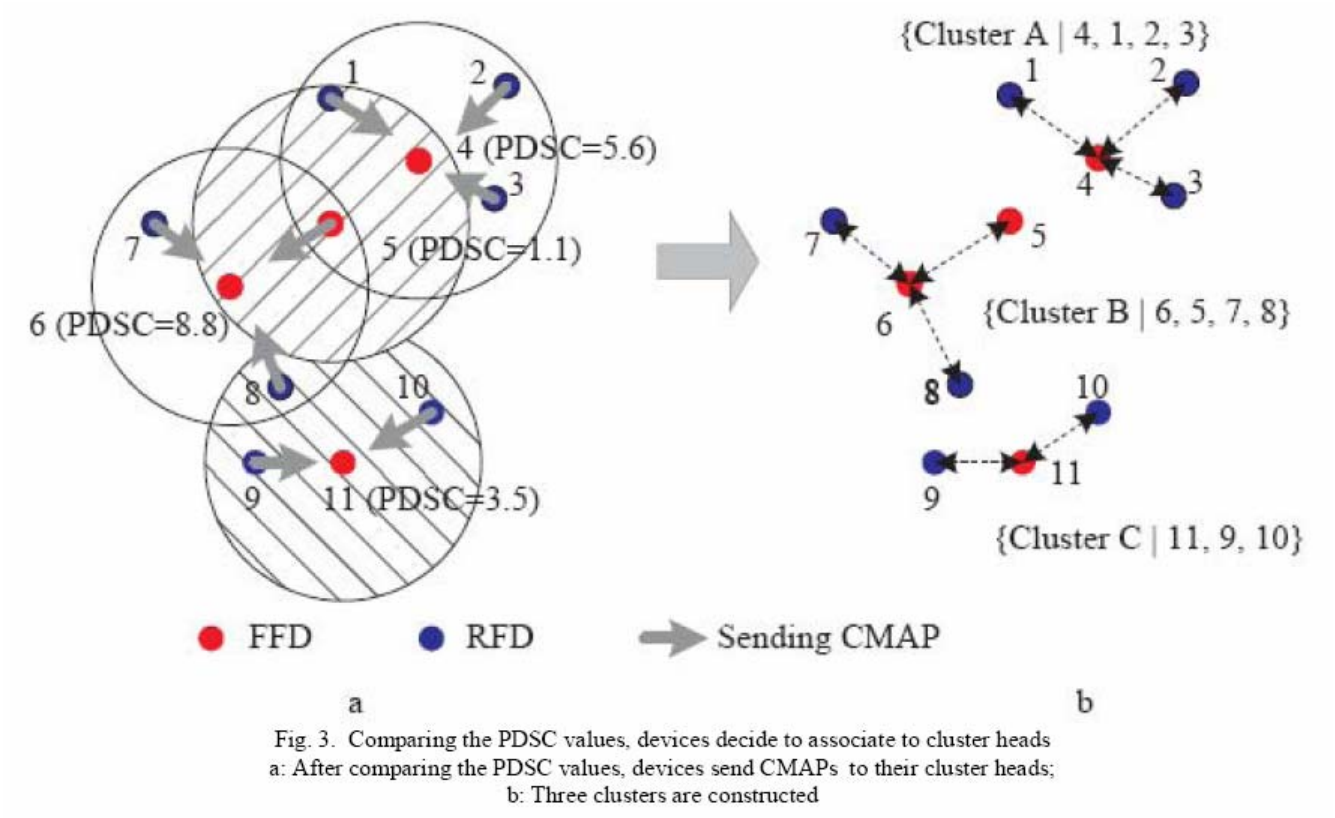


Fig. 3. Comparing the PDSC values, devices decide to associate to cluster heads
a: After comparing the PDSC values, devices send CMAPs to their cluster heads;
b: Three clusters are constructed

cluster-head-application packet (CHAP)

cluster-member-association packet (CMAP)

The Hierarchical Clustering Algorithm (2/4)

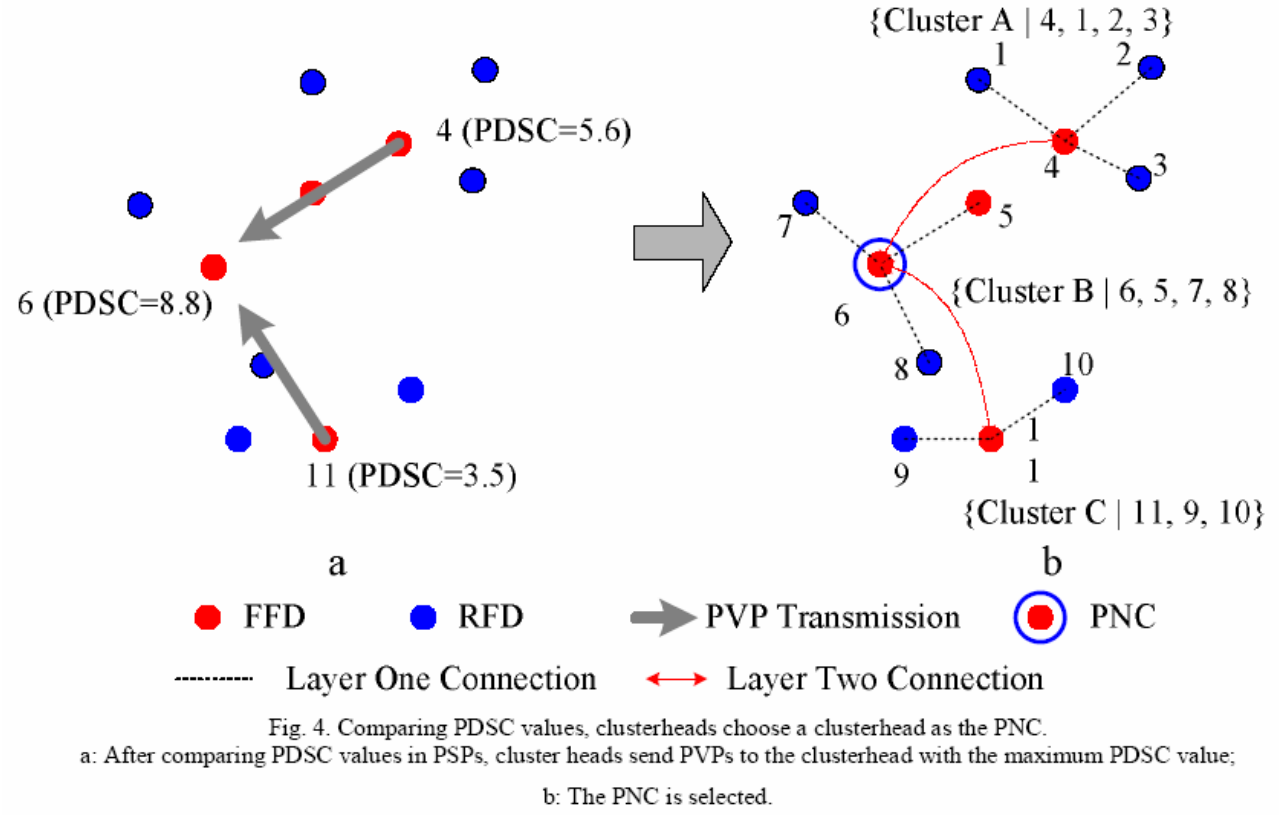
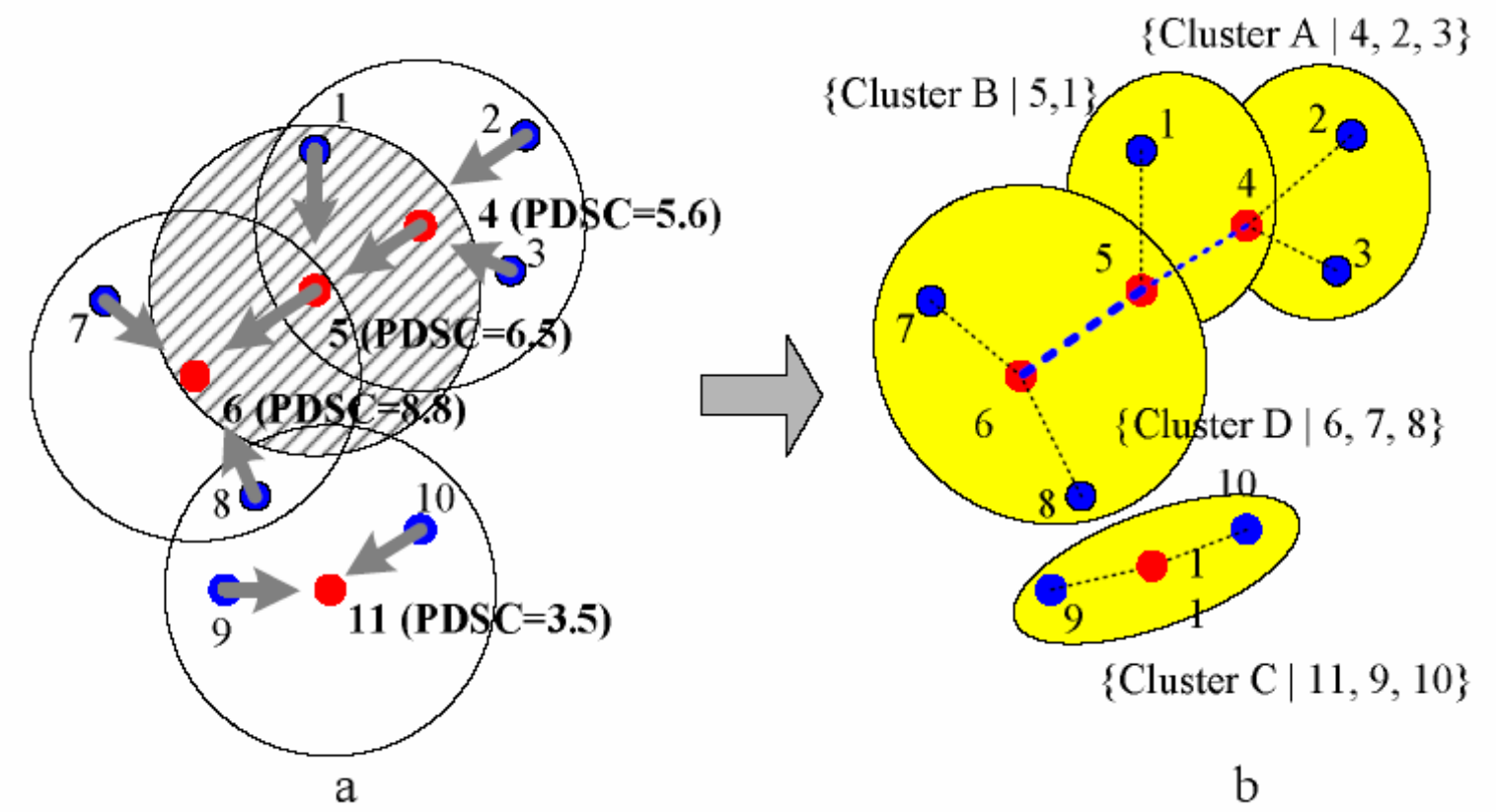


Fig. 4. Comparing PDSC values, clusterheads choose a clusterhead as the PNC.
a: After comparing PDSC values in PSPs, cluster heads send PVPs to the clusterhead with the maximum PDSC value;
b: The PNC is selected.

PNC-Selection packets (PSPs)

PNC-Voting packet (PVP)

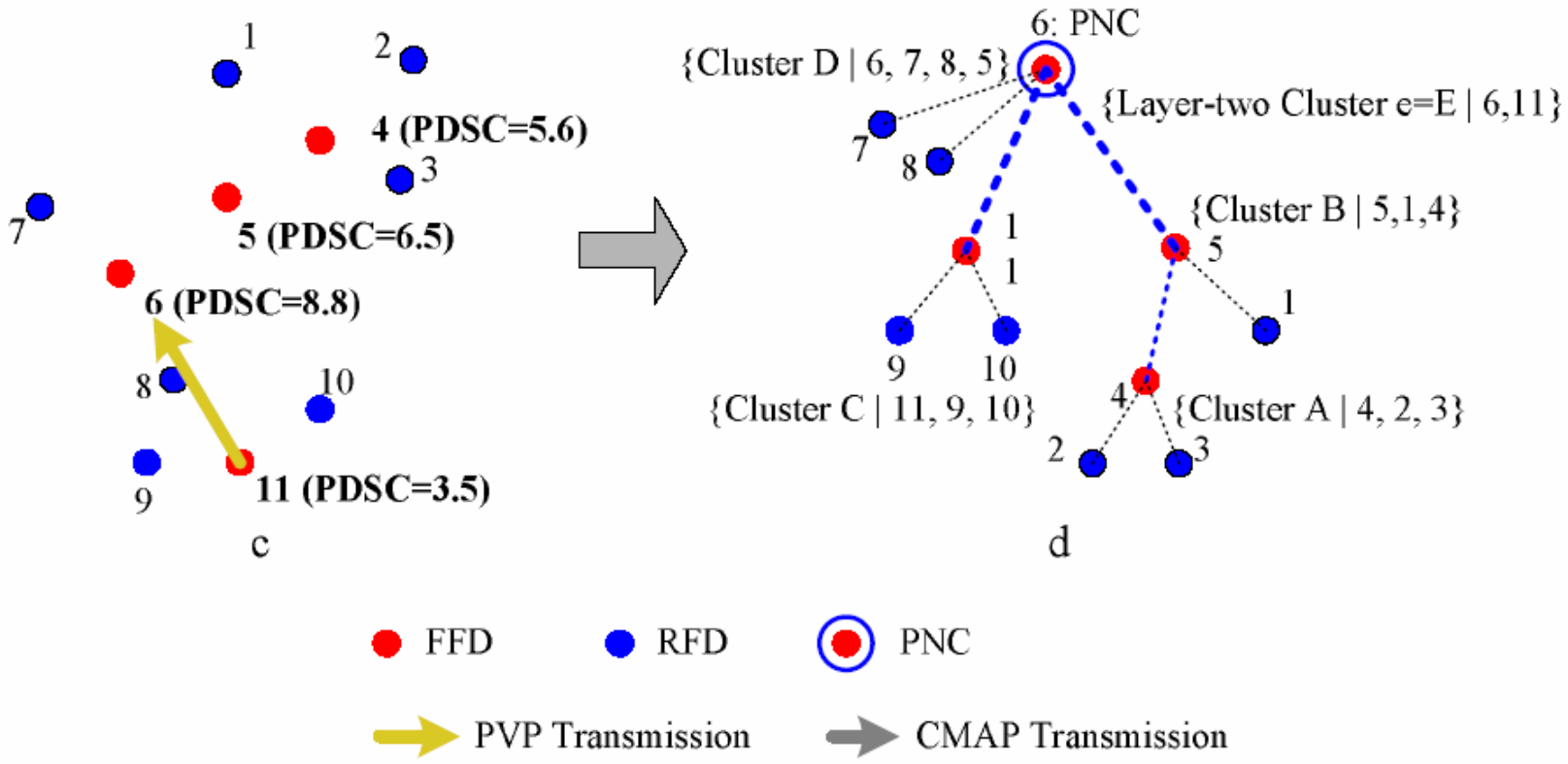
The Hierarchical Clustering Algorithm (3/4)



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)

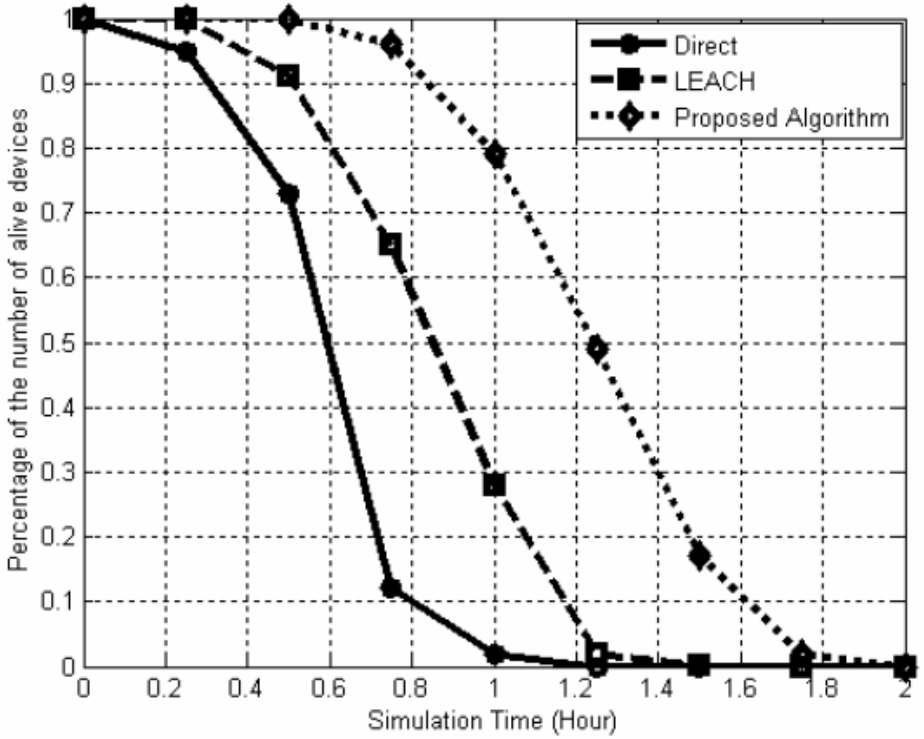


Fig. 6. Simulation results: node life time.

Simulation (2/2)

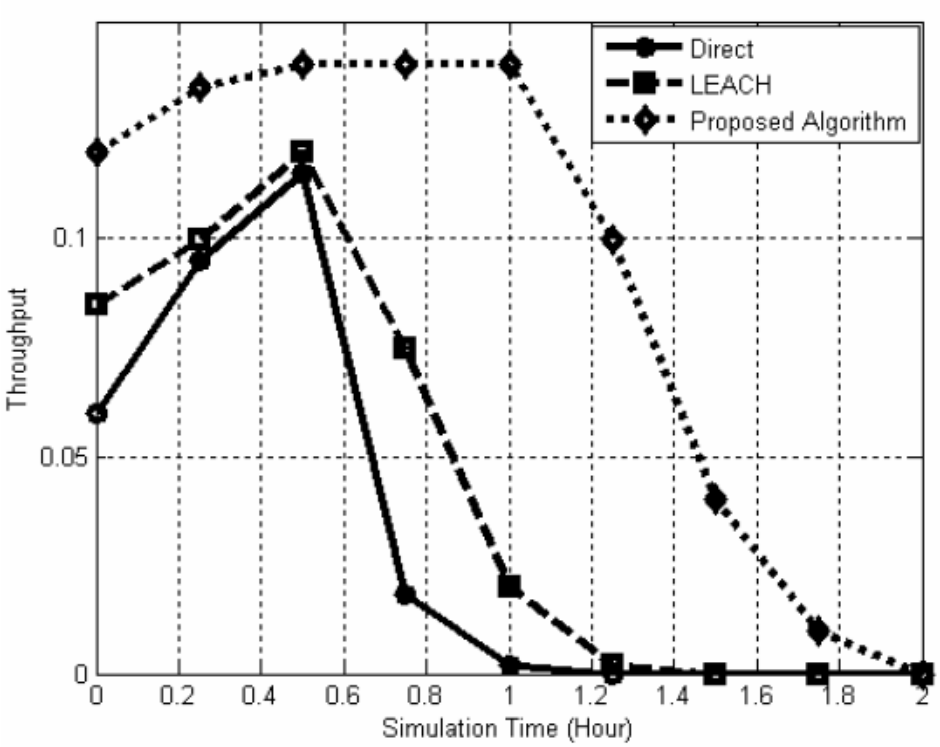


Fig. 7 Simuation results: throughput

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.