Scheduling Nodes in Wireless Sensor Networks: A Voronoi Approach

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Outline

- Wireless Sensor Network
- Dense Networks – problems and opportunities of this networks
- Scheduling Nodes Management Function
- Algothims
- Experiment Results
- Conclusions and Future Works

Wireless Sensor Networks

- WSN is used for monitoring and controling an environment (without human intervention).
- WSN is composed by a large number of sensor nodes deployed over an area and integrated to collaborate through a wireless network.

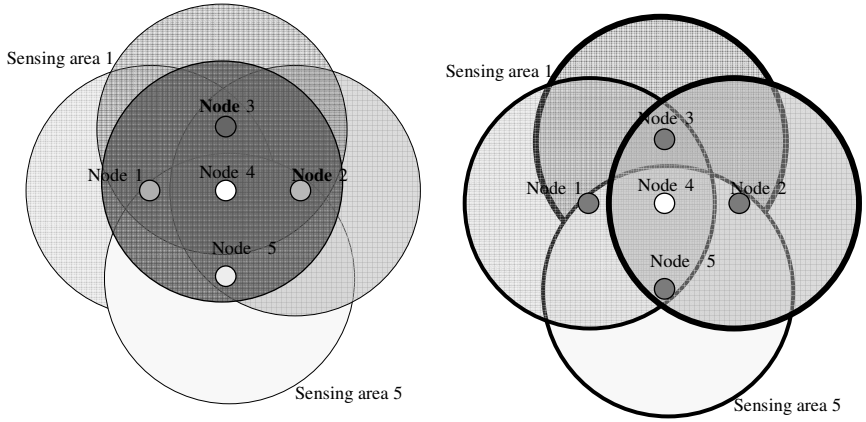
Wireless Sensor Networks

- A large number of sensor nodes allow the SENSING on a large geographical region with more accuracy than previously possible.
- WSNs with a high density of sensor nodes can present some problems and opportunities.

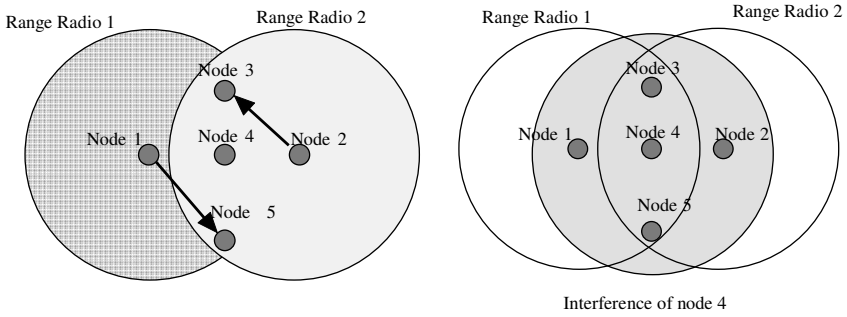
High density of sensor nodes can present

- Fault tolerance mechanism
- Increase precision
- Provide multi-resolution data
- Resource Reservation
- Overlapping of the sensing area
- Redundant data production
- Communication interference
- Energy waste

Example of Overlapping



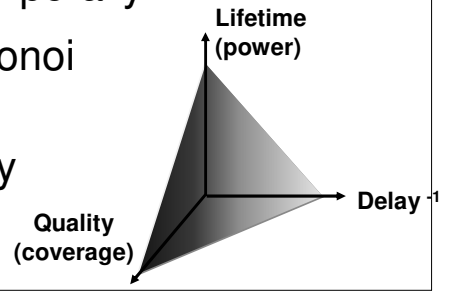
Example of Interference



All nodes transmit at the same frequency.

Objectives

- We propose a method to set up which nodes should be turned off or on.
- The management may take the sensor node out of service temporally.
- Our design uses a Voronoi Diagram.
- This schema is used by MANNA



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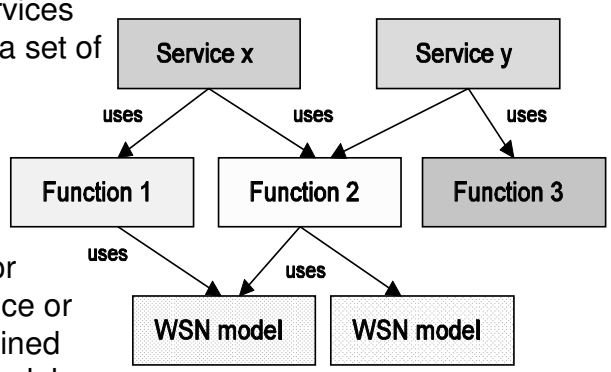
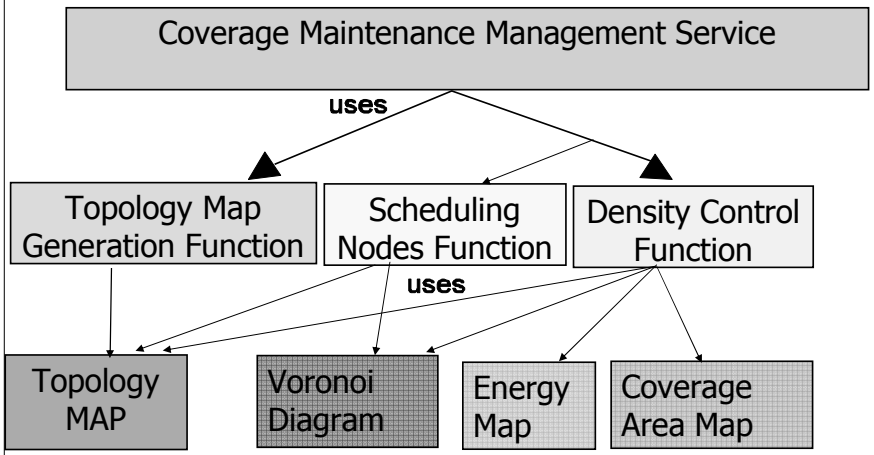
MANNA Architecture

- Management services are executed by a set of functions.
- The conditions for executing a service or function are obtained from the WSN models.



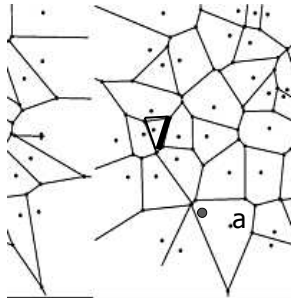
- It establishes automatic management services to provide self-management.

Scheduling Nodes Function



Voronoi Diagram

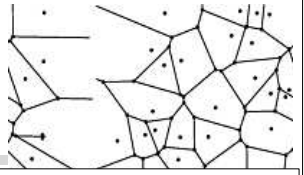
INPUT: a set of points (topology)



Output:Voronoi Diagram

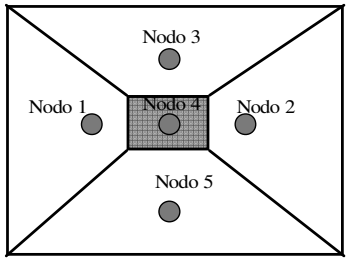
A Voronoi diagram decomposes the space into regions around each site, such that all points in the region around “a” are closer to “a” than any other point in S.

Algorithm

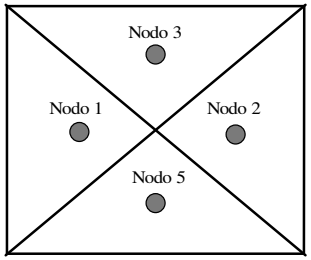


- The objective is to determine the area each node is responsible for.
- We pick up the node with the smallest area and if it is too small, the node should be turned off.
- The neighbors of that node become reponsible for that area, updating the Voronoi diagram.
- This process continues until there is a node responsible for an area smaller than a given threshold.

Example of the Algorithm that uses Voronoi Diagram to decide if a node should be turned off or on



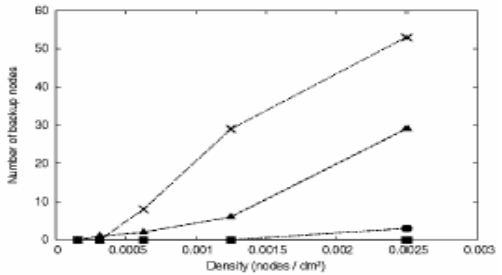
Initial Voronoi Diagram

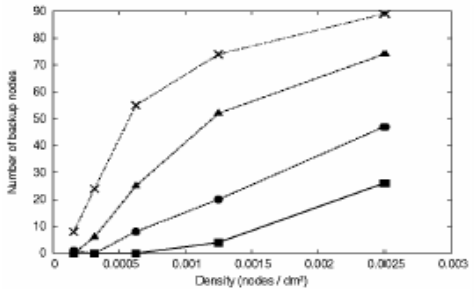


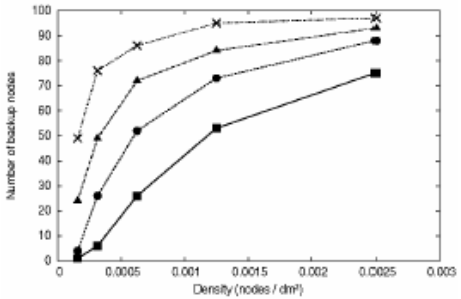
New Voronoi Diagram

Because node 4 is responsible for a small area (smaller than a threshold), the algorithm decides that node 4 should be turned off. At this step, there is no node responsible for a smaller area than the threshold, and it ends.

Experimental Results







Conclusion

- The MANNA considers the sensing coverage area a QoS metric.
- The sensing coverage area map gives the percentage of the desired area that is actually being monitored.
- We defined and evaluated a schema for determining which sensor nodes should be turned off.
- Simulation results shows that our approach is scalable.

Conclusion

- We show that our design can save energy without losing sensing area.
- We are implementing other versions of the algorithm using distributed approach, 3-D Voronoi Diagram, and other types of the network (hierarchical homogeneous, hierarchical heterogeneous).
- We are integrating this management function in the MANNA and we will compare this with other algorithm developed.

Thank you

- More details can be obtained with
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