



A Survey on Wireless Sensor Networks

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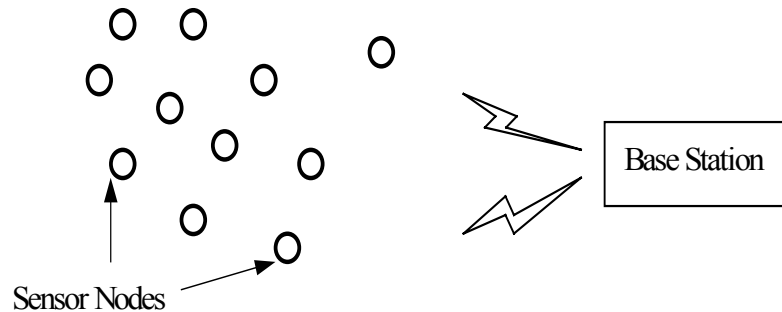


Outline

- Introduction
- Data-dissemination schemes
- Media access control schemes
- Distributed algorithms for collaborative processing
- Architecture for a WSN
- Network model

Introduction

A Wireless Sensor Network (WSN) consists of base stations and a number of wireless sensors.





Introduction (Cont.)

Applications of Wireless Sensor Networks

- Military and national security application
- Environment monitoring
- Traffic surveillance
- Medical application

Characteristics of Wireless Sensor Networks

- Low energy use.
- Dynamic and autonomous operation network.

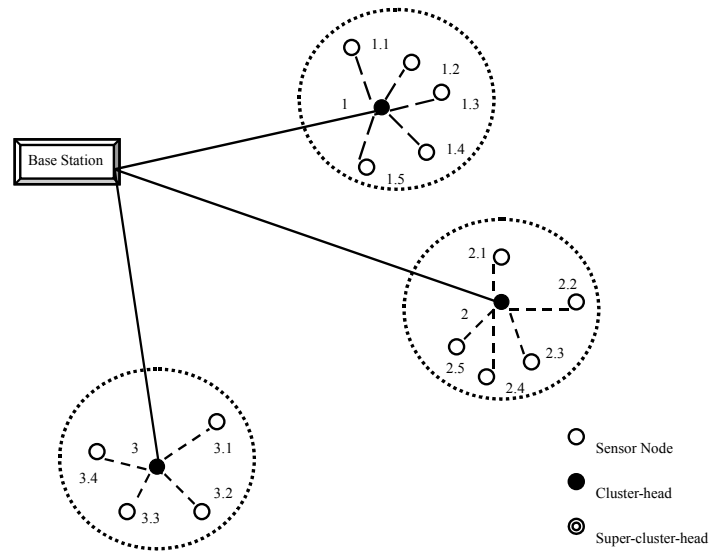


Data-dissemination Schemes

Conventional Methods

- Direct communication with the base station
 - Sensor nodes communicate with the base station directly.
 - Energy consuming.
- Multi-hop scheme
 - Transmit through some other intermediate nodes.
 - Energy consuming.

LEACH (Low-Energy Adaptive Clustering Hierarchy)

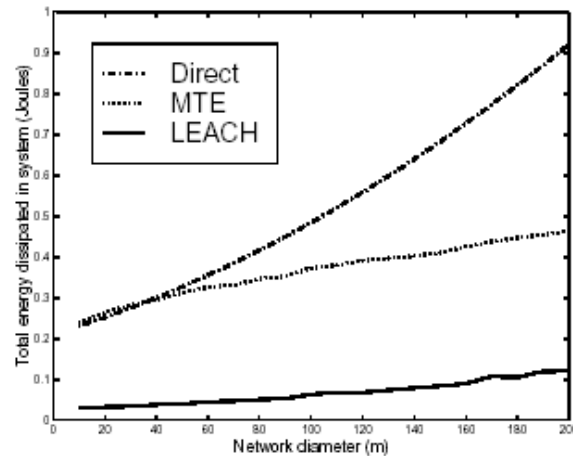


A Clustering Model

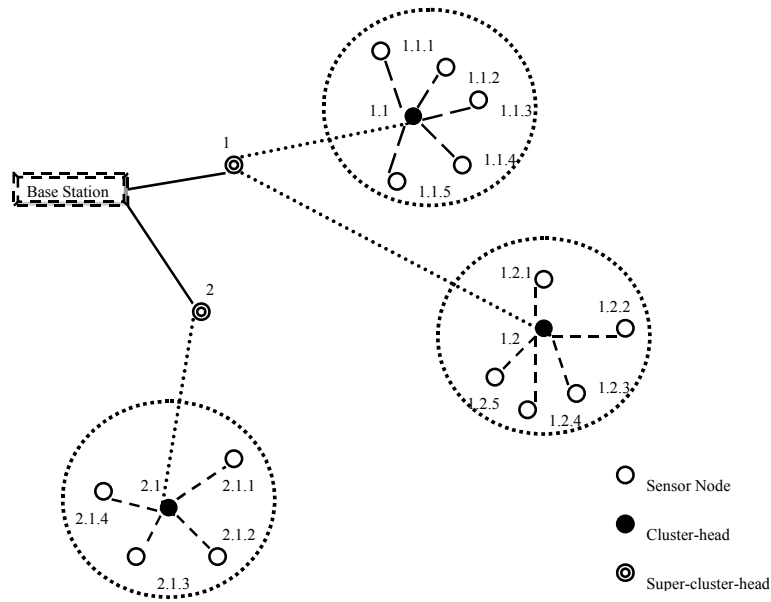
LEACH (Cont.)

The characteristics of LEACH

- Randomly rotating the cluster-head among sensors.
- Low energy consumption.



TEEN (Threshold sensitive Energy Efficient sensor Network Protocol)

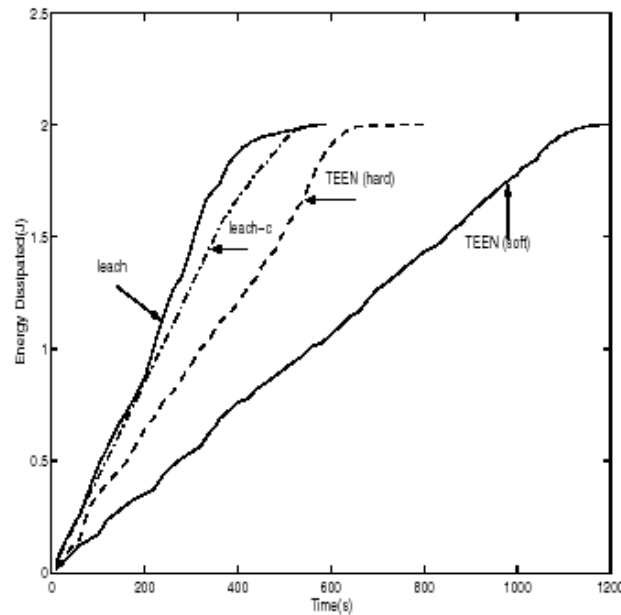


Hierarchical Clustering Model

TEEN (Cont.)

The characteristics of TEEN

- Apply hard threshold and soft threshold.
- Suitable for time-critical sensing application.





Media Access Control (MAC) Scheme

Two categories of MAC schemes for wireless networks

➤ Contention-based schemes

- Designed for minimum delay and maximum throughput.
- Require transceivers to monitor the channel at all times.

➤ Reservation-based or schedule-based schemes

- Detect the neighboring radios before allocating collision-free channel to a link.
- TDMA — a natural choice for sensor networks.



MAC Scheme (Cont.)

TDMA-based solutions

- The self-organizing “super frame” algorithm
 - Super frame = TDMA period + BOOTUP period + unused bandwidth
 - Performs well only under the specific conditions.
- Power Aware Clustered TDMA (PACT)
 - Divide the TDMA structure into control slot and data slot.
 - Hard to maintain the cluster when there are mobile nodes.



MAC Scheme (Cont.)

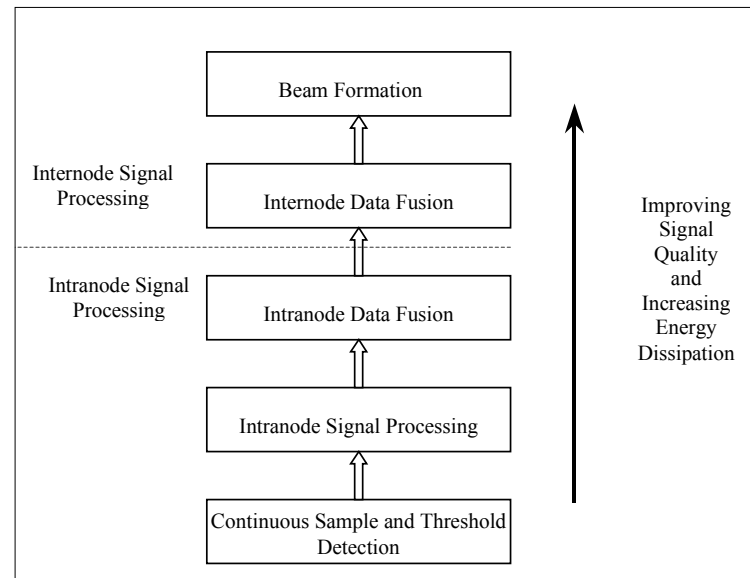
Other solutions

➤ Sensor-MAC (SMAC)

- Nodes periodically sleep.
- A node sleeps during transmission period of other nodes.
- Not suitable for time-critical applications.

Distributed algorithms for collaborative processing

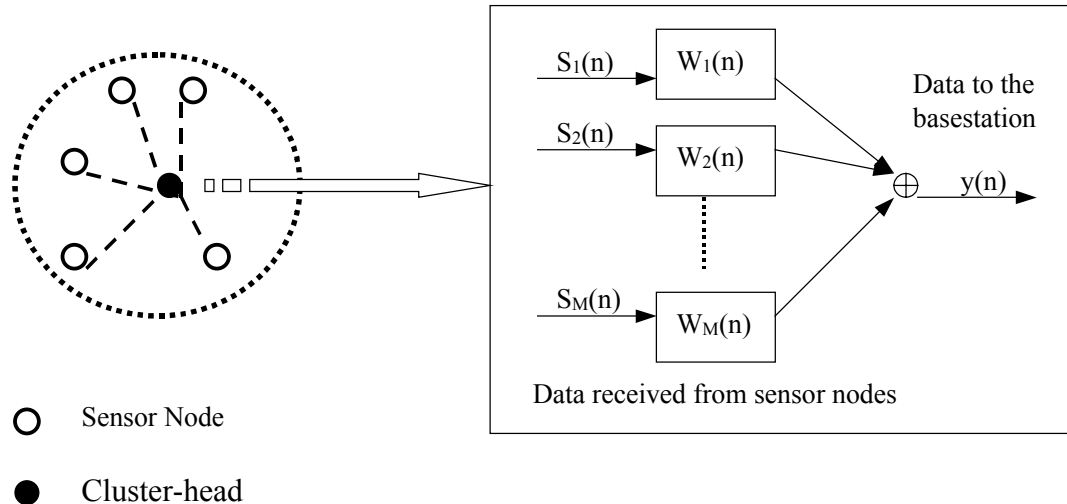
A layered architecture for cooperative signal processing



Distributed algorithms for collaborative processing (Cont.)

Beamforming

- Enhance the source signal and reduce the uncorrelated noise.
- Reduce the data redundancy.



Architecture for a WSN

Special addressing requirement

- Local unique addresses
- Data-centric

Example:

“What is the humidity at sensor # 130.18.64.74?”



“What is the average humidity in the northwest quadrant?”

“Which area has humidity higher than 50? ”

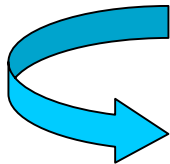
Architecture for a WSN (Cont.)

Attribute-based naming architecture

- Data is named by one or more attributes.
- Example.



“Which area has humidity higher than 50? ”



[type=humidity,
timestamp=01/01/2002/20:15:28,
location=60N/120W, humidity=60]



Architecture for a WSN (Cont.)

An address-free architecture (AFA)

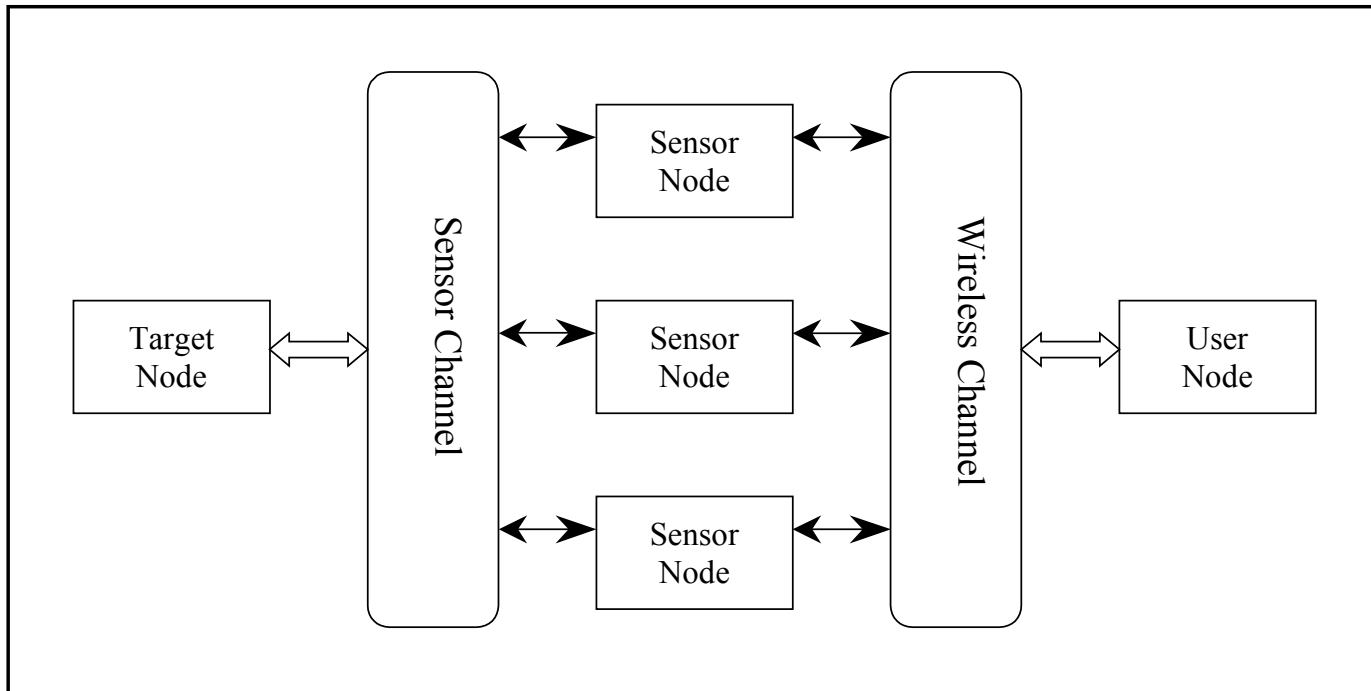
Advantage

- Randomly select probabilistically unique identifier for each transaction.
- Spatial locality.
- Temporal locality.

Drawback

- Not applicable when static addressing of nodes is needed.
- Identifier conflict.

Sensor Network Model





Open Research Issues

Data-dissemination schemes

Feasibility of some improved multi-hop schemes needs to be verified.

Media access control schemes

A TDMA-based MAC protocol requires time synchronization and is not scalable.

Distributed algorithms for collaborative processing

Communication-computation tradeoff should be considered when applying beamforming.



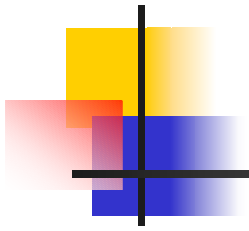
Open Research Issues (Cont.)

Architecture for WSNs

The architecture for applications that need static addressing of sensor nodes is anticipated.

Network Model

Energy consumption model and battery lifetime model are anticipated.



Thanks for your coming.