

Fault-Resilient Sensing

Nirwan Ansari, NJIT

Nei Kato, Tohoku University (Collaborator in Japan)

<http://web.njit.edu/~ansari>



On data gathering and security in wireless sensor networks

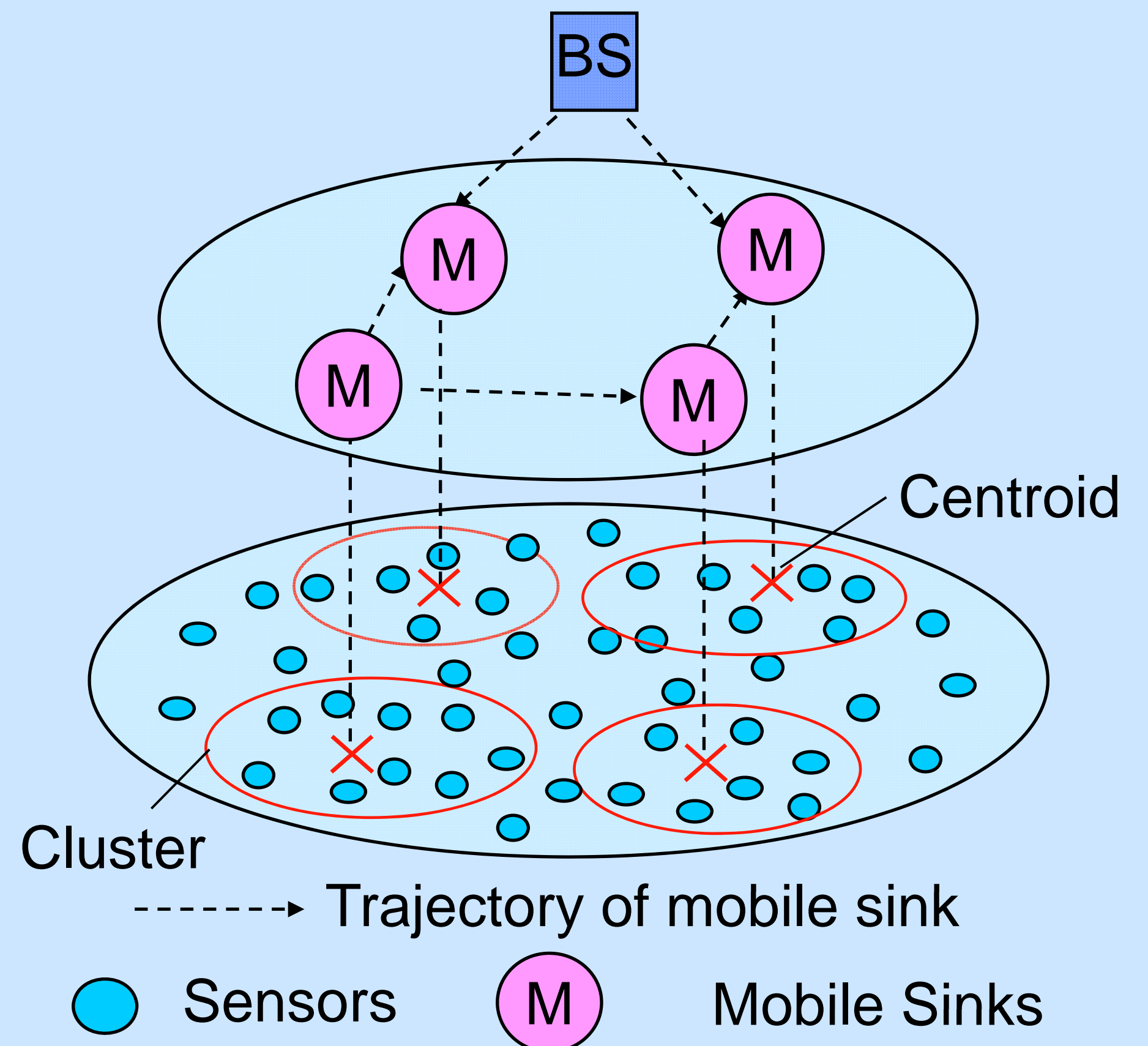
Mobile sinks, as agents transitioning between the sensor and ad-hoc networks, provide an energy efficient way for data gathering. However, mobility of sinks presents new challenges to routing and sensor distribution modeling.

Hybrid (MANET and WSN)

Sensors use WSN protocols (e.g., DD, SPIN) to communicate with each other. Mobile sinks use MANET protocol (e.g., AODV, DSR) to communicate with each other. Mobile sinks also use WSN protocols to query and relay data.

Application

By jointly concerting techniques used in ad-hoc and sensor networks, gathering data becomes more efficient and secure even with malfunctioned sensors caused by attacks or disasters because routes of mobile sinks can be easily modified.



Approach and Impact

New approach

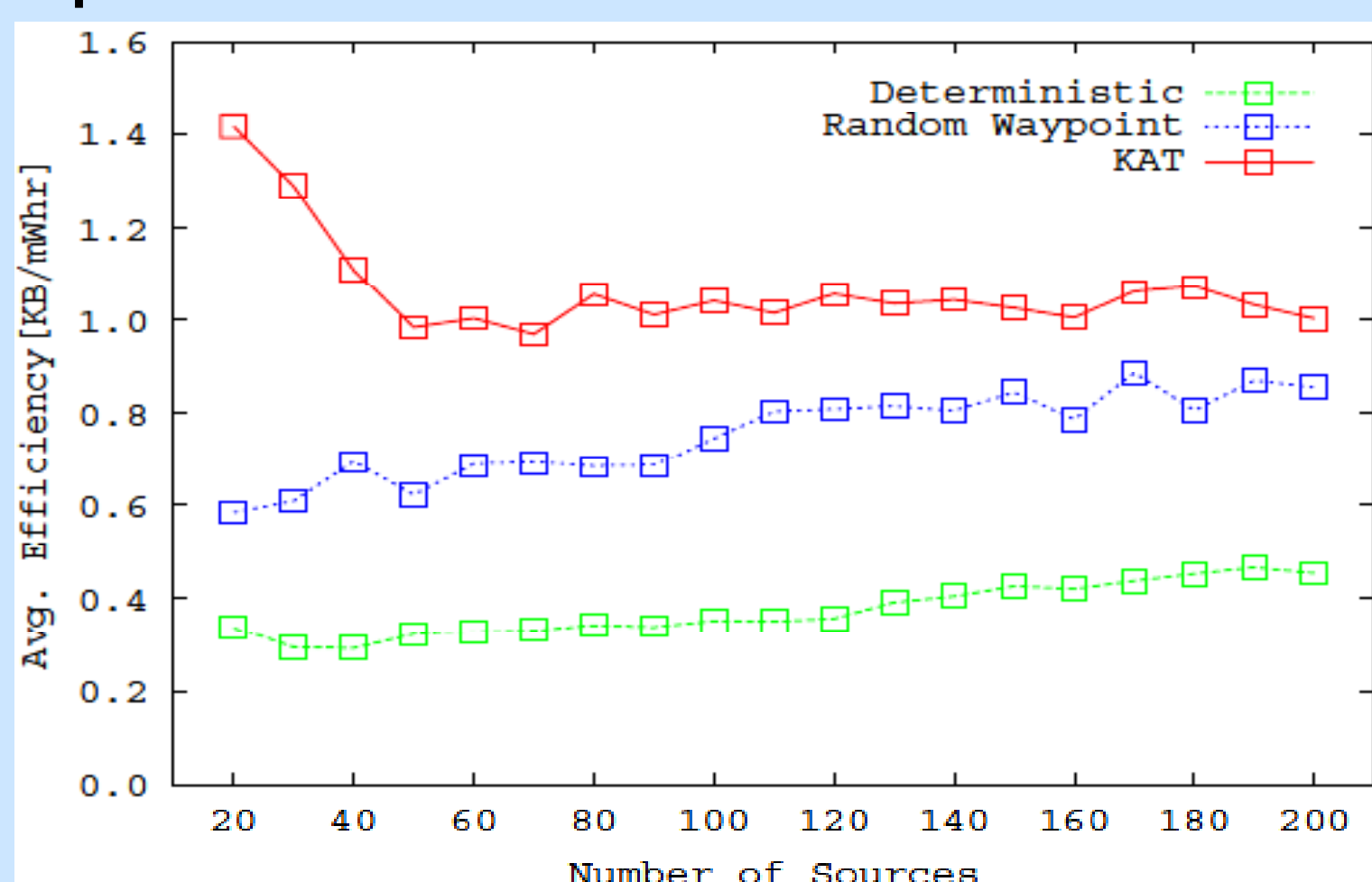
- Optimize the trajectory of mobile sinks
- Anomaly detection by statistical method

Research Impact

- Integrate mobile ad-hoc and sensor networks
- Secure data gathering with high efficiency and fault resilience

Data Gathering by KAT Mobility

A new scheme called K-means and Traveling Salesman Problem (TSP)-based mobility (KAT mobility) is proposed to navigate the mobile sink to traverse through the cluster centers according to the trajectory of an optimized route.



Anomaly Detection by Statistical Method

Define the state of each node by multi-dimensional feature vectors. With appropriate feature vectors, almost all kinds of attacks can be detected theoretically when there are sufficient resources in ad hoc nodes. Select the normal nodes for training/learning by Principal Component Analysis (PCA) and dynamically update the states. Nodes exceeding the dynamically updated threshold are considered under attack.

Detection rate (5 kinds of attacks)

Conventional method: 42.6%

proposal 1: 73.5% (only recent states)

proposal 2: 97.1% (dynamically updating states)