Design and Modelling of Energy Efficient WSN Architecture for Tactical Applications

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Wireless Sensor Networks (WSNs)

- A collection of spatially distributed sensors
- Cooperatively work together to gather the desired data from a monitored area.
- Data is forwarded to base station
Applications of WSNs

WSNs play a critical role military Intelligence, Surveillance, and Reconnaissance (ISR).
Research Questions

• Limited energy so need to be efficiently used
  – Nodes around sink deplete their batteries
  – Node deaths and disruption of topology

• Solution is Mobile sink (MS)
  – But, overhead of updating the location of sink and data delivery latency

• How to choose optimal design parameters?
WSN Network Architecture

(a) Single-hop based on flat
(b) Multi-hop based on flat
(c) Single-hop based on clustering
(d) Multi-hop based on clustering
CMSDM Benefits

- Emergency data is delivered immediately.
  - MS is moved to emergency region
- Low energy consumption
  - One hop communications
  - Data aggregation and compression
- Low probability of detection (LPD)
- Scalability & Robustness
Markov Decision Process (MDP) of UGV
Total Number of Transmissions
Total Number of Transmissions

- Energy consumption increases drastically for static sink WSNs
- CMSDM has least energy consumption
- In case of sporadic emergency data, then move MS to center of WSN
Avg Number of Transmissions Per Node
Avg Number of Transmissions Per Node

• Static sink WSNs are not scalable

• CMSDM performance is ideal
Minimum Expected Latency for Data Delivery
Data Delivery Latency

- Data delivery latency grows quickly for the larger WSNs
- Presence of control greatly reduces latency
Conclusion

- CMSDM is a better choice in delay tolerant networks
- Formal modeling techniques help in making critical WSN design choices
- More complicated MDPs can developed to study influence multiple MSs, operator skills and fatigue