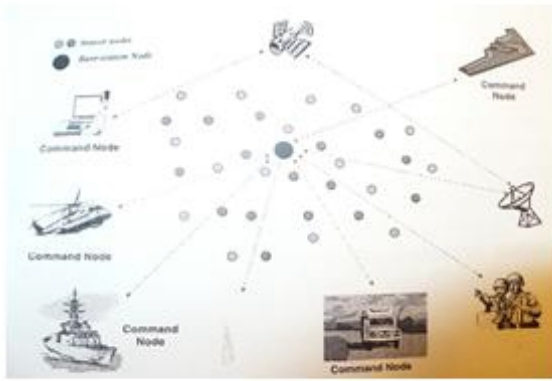


Challenge in designing WSNs

- Support of the functional
 - Data latency
- Non-functional
 - Data integrity
 - Requirements with coping with the computation, energy and communication
- Careful node placement can be a very effective optimization.
 - Static node placement
 - Dynamic node placement

- Role-based placement strategies
 - Relay node placement
 - More powerful, longer range
 - Connect to separated segments
 - Data collector placement
 - Cluster-head
 - Collect and aggregate the data

Wireless sensor network



- The base-station is deployed in the center of the network to collect data from other sensors

Nodes' position affect

- Nodes' positions affect numerous network performance metrics
 - Coverage (careful planning of node density)
 - Energy consumption ↑
 - Delay ↑
 - Throughput ↓

Optimal node placement strategy

- Optimal node placement(NP-hard)
- Whether the optimization is performed at the time of deployment or while the network is operational.
 - Static strategy (structural quality metric)
 - Distance
 - Network connectivity
 - Fixed topology
 - Dynamic strategy
 - Initial placement become void

Static node placement

- Deployment methodology
 - Control (predetermined position)
 - Random (harsh environment)
- Optimization objective
 - Area coverage
 - Network connectivity
 - Network longevity
 - Data fidelity
- Node's role in WSN
 - Sensor, relay, cluster-head, base-station

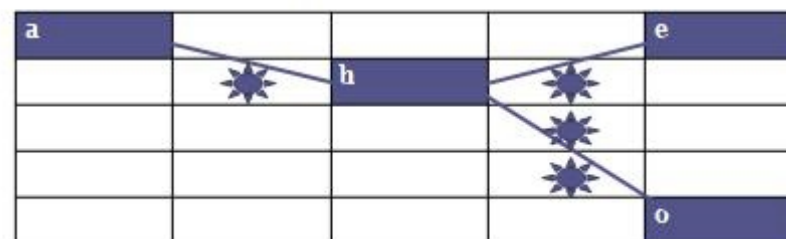
Dynamic reposition of nodes

- Dynamically repositioning the nodes while the network is operational is necessary to further improve the performance of the network.
- Relocating the nodes during regular network operation is very challenging.
 - Continual monitoring of the network state and performance and analysis of event happening

Relocation issues

- When to consider relocation:
 - Unacceptable performance measure
 - Desire to boost such measures beyond what is achievable at the present node position
- Challenge
 - The node needs to qualify the impact of repositioning at the new location on the network performance and operation.
 - Relocation overhead
- Where to relocate:
 - Finding an optimal location for the node in a multi-hop network is a complex problem.
- Managing and justifying the move:
 - Find a travel path
 - Total distance to be traveled, terrain, the path safety and the risk of disrupting the network operation
 - Minimizing the travel distance

Reposition relay node



Build MST between segments (a, h, e, o) by Prim's algorithm
Find the minimal edge at a time by linear programming
A-h, a-e, a-o, h-e, h-o, e-o

Repositioning data collector(DC)

- DC has ability to gather sensor data and do computation as well.
- Unlike sensor repositioning, the goal for relocating DCs is usually not local to the individual node and involves numerous network state parameters.

Repositioning for increased network longevity

- The main idea is to move the DC towards the sources of highest traffic.
- The traffic density (P) times the transmission power(E_r) is used as a metric for monitoring the network operation and searching for the best DC location
- $P \cdot E_r$
- Track changes in the **nodes** that act as the closest hop to the DC and the **traffic density** going through these hops.

Enhancing timeliness of delay-constrained

- Repositioning DC is useful when real-time traffic with certain end-to-end delay requirements is involved.
- **Spread the traffic** on additional hops and increase the feasibility of meeting the timeliness requirements.

Maintaining uninterrupted operation

- Relocation the DC to keep WSNs operational without interruption.
- Keeping the DC away from the harm.
 - DC may be in the way of an approaching a serious event.
 - Moving the DC node towards the data sources to boost network performance.
- The idea is to track the DC safety levels at different locations and use this information to define the parameters of the DC safety model.
- Object function:
 - Safety
 - Performance goals
 - Minimize the travel distance
- Safe route for the DC to its new position.

Future work

- Coordinated multi-node relocation



- Nodes close to the data collector die rather quickly due to traffic overload. Forcing the more distant nodes to deliver the data to the DC

- A sample multi-cluster sensor network architecture, where each cluster is handled/managed by a distinct cluster-head