

Optimization Approaches to Wireless Sensor Network Design and Operation for Prolonged Network Life

Hui Lin

Texas A&M University

Logistics/Networked Systems Research Laboratory

Department of Industrial and Systems Engineering

College Station, TX

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PI: Halit Üster

Introduction

A *sensor* is a small, inexpensive device with on-board sensing, processing/storage, transceiver and power units.

A group of sensors communicating in a wireless medium for the purpose of gathering information and transmitting it to user nodes form a *sensor network*.

Employed in inhospitable environments and difficult-to-reach terrains to monitor and track movements, in wild habitats to monitor and observe natural phenomena and a host of others.

Research Topic

We focus on the design and operation decisions for randomly deployed large-scale wireless sensor networks.

Three levels of decision making process include

Sensor (Re)Deployment, Topology Discovery, and Routing.

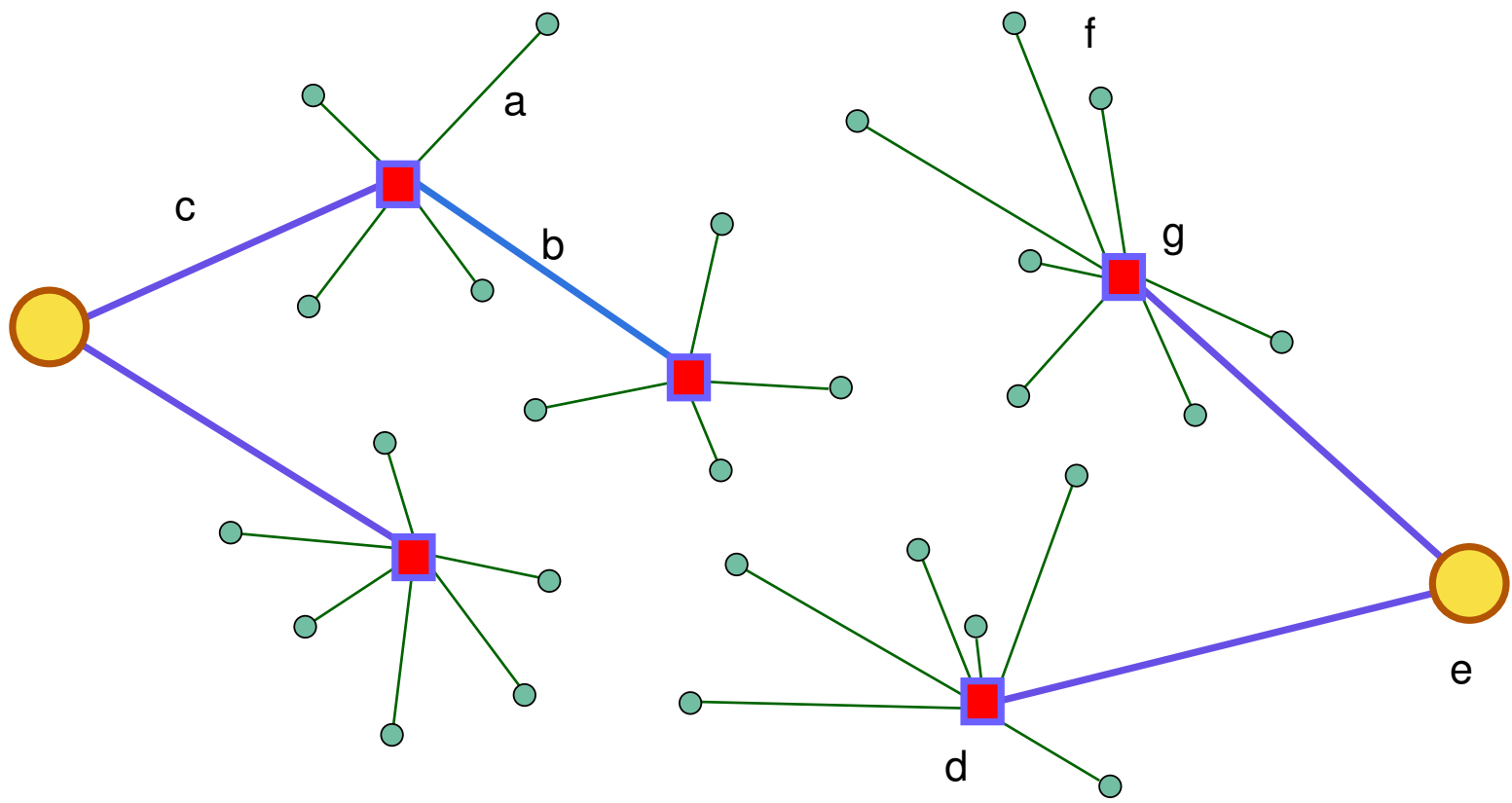
Three design/operation attributes include

Energy Efficiency, Fault Tolerance, and Comp-Comm Trade-offs.

However, current literature heavily concentrates on making decisions in these three areas in a disaggregated fashion.

We investigate integrated design and planning methodologies in the three decision making levels under simultaneous consideration of the design/operation attributes.

A Sample Topology



Current Research

- Wireless Sensor Network Design/ Routing Problem.
- We consider an integrated mathematical formulation with various objectives to define policies that promote efficiency in energy usage and prolong the network lifetime.
- The objectives include combinations of maximum and average energy usage at a sensor node and the remaining energy distribution at the sensor nodes.
- Even small size problems are highly impractical to be solved using exact optimization methods, thus we develop efficient heuristic methods.

Summer Plan

- We aim to test our current algorithm that integrated topology and routing decisions on larger network instances.
- We will be able to obtain benchmark results and generate a large test-bed via Cyberinfrastructure resources.
- The possibilities of implementing our partitioning based approaches using the parallel computing capabilities at SDSC.
- We aim to utilize visualization to support our optimization results.