Multihop Routing Experiments on a 100-Node Sensor Network

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> **2026 editorial context (not part of the original post).** Performance objectives, collaborators, original photographs, testbed topology, and analysis of energy and delivery success.
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> 2026 context: rigorous evaluation of physical wireless networks with real experimental constraints.

Original 2012 archive text

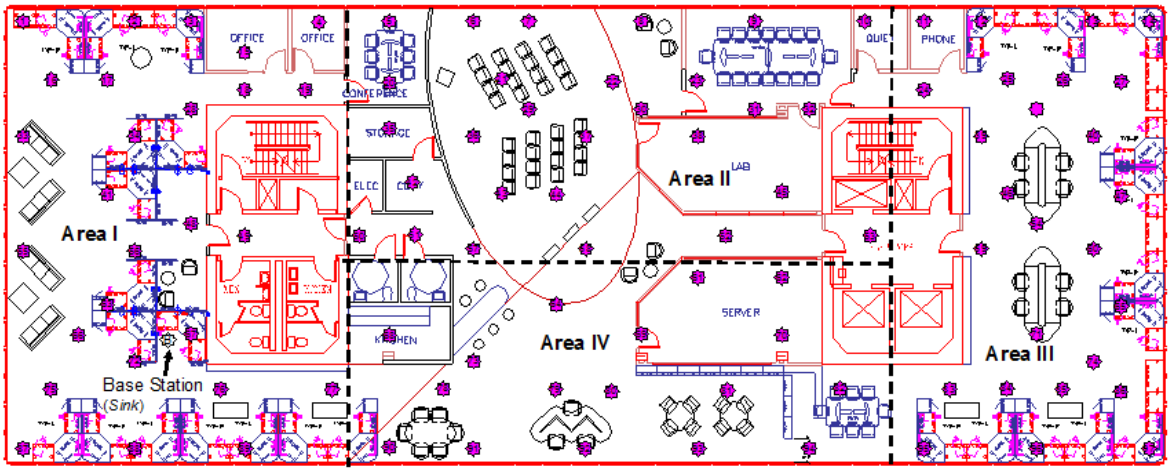
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Modular architecture of TinyOS, an operating system for sensor nodes, presents a set of components that can be combined in multitude of ways to get a desired level of functionality. The current implementation included in TinyOS 1.1. provides configurable network, link and radio layers, which can be combined to form an integrated routing layer with specific properties. e. g. for a network system requiring data reliability with stringent power needs and reasonable system interactivity, link layer acknowledgements can be combined with the *Low Power Listening* radio stack to get the desired functionality. We wanted to see which combination of network, link and radio layer performs the best based on two main performance metrics - power usage on each sensor node and the data success rate (fraction of requested data received). Network scalability was another issue we wanted to look at. Can a large Sensornet scale with number of nodes while still retaining a high successrate across all the nodes? If the answer is yes, then how well it can perform and; if no, then we want to find the reasons for the bad performance.



The 100 node test bed: A typical inverted tree used for routing data to the base station (sink)

A Sensornet deployment can be characterized by a set of parameters namely sample interval of the sensor readings, scale, sensor node distribution, and radio characteristics of the deployment area. Consider the recent sensor deployments, namely BP ship, Intel Fabapp, Great Duck Island, Golden Gate Bridge, and Redwood deployment. All these deployment were long term spanning several days/months. But they varied in the sampling period of sensor readings, data transfer (bulk vs. small sensor readings), scale (the number of nodes in the system), and environmental conditions. Redwood Deployment required a sampling period of 5 minutes as oppose to the BP deployment where the sampling period was 16 hours. Sensors in the BP ship deployment were placed in a harsh environment inside a ship monitoring vibration readings in the motor room. The RF characteristics varied across each deployment. Golden Gate deployment tracks local stresses on the Golden Gate Bridge. Since the sensors are placed in the vicinity of the vast metal structure (the bridge itself), the radio waves are attenuated. The Redwood tree deployment was in the outdoor space. BP ship deployment was inside the ship around heavy machinery. We wanted to characterize the effect of these deployment dependent parameters on the different routing combinations. A performance characterization of these parameters is expected to give some insight on which routing layer combination to use for a specific deployment.

We present the results obtained from the evaluation of different combinations of radio, link and network layers available (Standard, Mint, Reliable, Reliable Low Power, Reliable Time Sync, and HSN DSDV) on a testbed of 100 *mica2* motes at Intel Berkeley Research Lab.

[Image missing from Blogger export: original authoring-file reference.]