Pervasive Systems Centre

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Wireless Sensor Networks for Localised Maritime Monitoring

Pedro N. Barbosa*, Nick R. Harris, Neil M. White

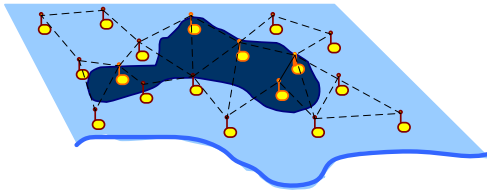
*email: pneb06r@ecs.soton.ac.uk; web: http://www.ecs.soton.ac.uk/people/pneb06r/; tel. +44 (0)23 8059 4996
Electronic Systems and Devices Group, School of Electronics and Computer Science, University of Southampton, SO17 1BJ, UK

Project Aims

To develop algorithms and protocols that can improve the scalability of sensor networks by using cluster-based routing mechanisms. The network must be able to balance energy consumption between nodes and maintain message latency under predetermined values.

Oil slick Monitoring

Continuous monitoring of short term marine environmental events provides the response teams valuable information to effectively select the most adequate cleaning procedure. By deploying sensor nodes on the water, it is possible to monitor events continuously and with high accuracy.



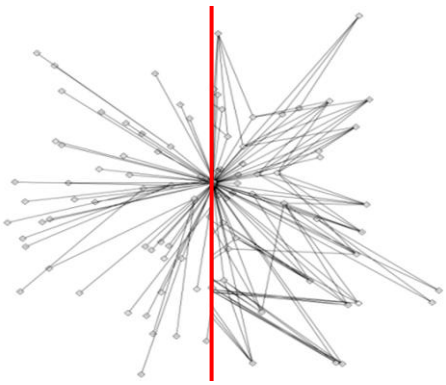
Example of a WSN deployment on sea

Deploying sensor networks on water provides a scenario where the number of sensors can easily extend up to several thousands. Also, as the weather conditions can be extremely harsh, sensing and communication between nodes will be affected. The nodes will drift with the currents, and move and incline with the waves.

To make the most out of the resources available, as well as to improve data delivery, sensors must work in cooperation with each other. We propose a novel clustering algorithm that focus on three main aspects: (1) distribute energy consumption more evenly across the network; (2) provide routing strategies that support a large number of nodes; and (3) optimize message delivery in conditions where connectivity is poor. To this extent, opportunistic and cooperative message transmission can increase the probabilities of message delivery.

Intra-cluster Routing

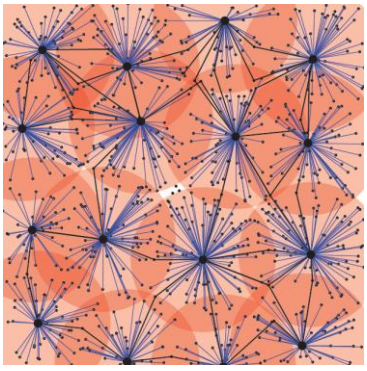
The focus so far has gone into optimising energy distribution in intra cluster communication. As standard IEEE 802.15.4 transceivers require about the same amount of energy to send and receive data, there is no real saving with the use of multihop. However, with long-range transceivers that use at least twice as much power to transmit as they need to receive data, multihop becomes a feasible alternative.
Two two-hop routing algorithms have been developed, and showed improved energy distribution across the nodes when compared with singlehop and greedy algorithms.
Two-hop routing provides improved energy distribution when compared to single hop, while avoiding the excess latency of multihop algorithms such as greedy.



Two hop routing strategies

Inter-cluster Communication

Each cluster head must support dynamic network management to adapt to current weather conditions. Each cluster head attempts to communicate with its neighbours directly and, in the case where that is not possible, they will use one of the nodes within the range of both to relay the messages. Ultimately, with a careful distribution of cluster heads, these will form an upper tier to transmit data across to a sink node.



Cluster coverage and communication links

References

1. Barbosa, P.; White, N.M.; Harris, N.R., "Wireless Sensor Network for Localized Maritime Monitoring," Advanced Information Networking and Applications - Workshops, 2008. AINAW 2008. 22nd International Conference on , vol., no., pp.681-686, 25-28 March 2008
2. Fitz, S.; Gonzalez-Velazquez, A.; Henning, I.; Khan, T., "Experimental investigation of wireless link layer for multi-hop oceanographic-sensor networks," Electronics Letters , vol.41, no.24, pp. 1310-1311, 24 Nov. 2005