Mobile tolerant hybrid network routing protocol for wireless sensor networks

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Wireless sensor networks (WSN) may consist of hundreds or even thousands of nodes and could be used for a multitude of applications, such as warfare intelligence or to monitor the environment. A typical WSN node has a limited and usually irreplaceable power source and the efficient use of the available power is of utmost importance to ensure the maximum lifetime of each WSN application.

Each of the nodes needs to transmit and communicate sensed data to an aggregation point for use by higher layer systems. Data and message transmission among nodes collectively consume the largest amount of the energy available in a WSN. The network routing protocols ensure that every message reaches the destination and has a direct impact on the amount of transmissions to deliver messages successfully.

To this end, the transmission protocol in the WSN should be scalable, adaptable and optimised to consume the least possible amount of energy to suit different network architectures and application domains.

Research conducted in the Department of Electrical, Electronic and Computer Engineering proposed a mobile tolerant hybrid energy-efficient routing protocol (MT-HEER), where hybrid refers to the inclusion of both flat and hierarchical routing architectures as proposed in the hybrid energy-efficient routing protocol (HEER). HEER was previously developed at the University of Pretoria and formed the starting point of the current research project.

The inclusion of mobile nodes in the WSN deployment proved to be detrimental to protocol performance in terms of energy efficiency and message delivery. This negative impact could be attributed to assuming that all nodes in the network are statically located. In an attempt to adapt to topological changes caused by mobile nodes, too much energy could be consumed by following traditional network failure algorithms.

MT-HEER introduces a mechanism to proactively track and utilise mobile nodes as part of the routing strategy. The protocol is designed with the following in mind: computational simplicity, reliability of message delivery, energy efficiency and – most importantly – mobility awareness. Messages are propagated through the network along a single path, while performing data aggregation along the same route. MT-HEER relies on at least 40% of the nodes in the network being static to perform dynamic route maintenance in an effort to mitigate the risks of topological changes due to mobile nodes. Empirical tests and results have shown that MT-HEER performs as expected by preserving energy within acceptable limits, while considering the additional energy overhead introduced by dynamic route maintenance.

Mobile node tolerance is evident in the protocol's ability to provide a constant successful message delivery ratio at the sink node with the introduction and increase in the number of mobile nodes. MT-HEER succeeds in providing tolerance to mobile nodes within a WSN, while operating within acceptable energy conservation limits.

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