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Throughput Improvement of Randomly Deployed Wireless Personal Area networks

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Abstract

Throughput is the key parameter used to estimate the quality of service of the Wireless Personal Area Networks (WPAN). Throughput of the network is degraded mainly due to the packet loss. The Packet loss problem is more in the networks, in which the nodes are deployed randomly. There are three significant factors responsible for packet loss in wireless Personal Area networks. They are, interference of co-existed networks working in the same frequency band, collisions due to co-located networks, and failure of intermediate nodes near the sink due to their over usage. In this paper, authors propose a solution to solve the problem of packet loss due to over usage of the intermediate nodes. The authors propose a routing algorithm, based on the remaining energy at the intermediate nodes, to prevent the over usage of intermediate nodes. Remaining-energy based Adaptive Multi-hop Algorithm (RAMA), which takes the routing decision based on the remaining energy at each of the neighbouring nodes and adopts short distance multi hop communication to relay the data from source node to sink node. The algorithm is implemented on TI wireless sensor nodes, and the performance is compared with SimpliciTI protocol. The experimental results show that a 27% improvement in the throughput is achieved with the proposed algorithm RAMA.

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Keywords: Wireless Personal Area Networks; Throughput; random node deployment; packet loss; interference; Collisions.

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1. Introduction

1.1. WPAN Standard

The IEEE 802.15.4 is an emerging standard for Low Rate Wireless Personal Area Networks (WPANs). The main goal of this standard is to provide low power, cost effective, flexible and scalable Wireless Networks [1]. The networks transfer the data at 250kbps and support 65,536 nodes, the number of nodes will be increased in near future. The rapid progress in wireless technologies with low cost and great mobility ensuring that these technologies are used in many contexts[2]. Now- a-days, IEEE 802.15.4 WPANs are widely used in a large number of applications, such as healthcare monitoring, Industrial automation, smart home, remote metering applications, and the number of applications utilizing IEEE 802.15.4 is exponentially increasing [3],[4].

1.2. The Packet Loss Problem

In many applications, including battle field, surveillance, the nodes are randomly deployed. In such networks, the packet loss is due to coverage problem [5],[6]. However, because of low cost and low power consumption, many applications like home automation, many nodes deployed in the small area and forming the high density networks. The coverage problem does not exist in high density networks. The probability of packet loss in such a high density networks is due to collisions and congestion and node mortality due to over usage. Reducing packet loss is a complex task and the cross layer approach is required to be adopted. The control is required to be implemented at physical layer, Data link and higher layers also. The randomly deployed nodes forms into cluster tree topologies, in which the nodes near to the sink are over used due to convergent nature of the multi hop ad-hoc networks and will die much before the other nodes [7]. This causes the packet loss in the network. The packet loss problem can be solved to certain extent by using the efficient Routing protocol. However designing a good routing protocol for the wireless networks in which the nodes are deployed randomly is a very complex task[8]. Absence of central control and time varying nature of the topology are further increasing the complexity in designing a good routing protocol. This problem can be reduced by distributing the load among the nodes and routing the packets from source to sink via different intermediate nodes based on the energy available at respective nodes. It avoids over usage of any of the intermediate nodes.

1.3. The Cluster-Tree Network

In Wireless Personal Area Networks, when the nodes are deployed randomly, the nodes are organized into a network topology called Cluster-tree topology.

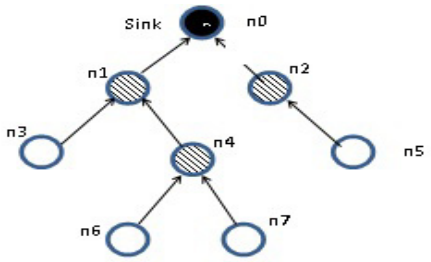

Fig. 1. The Cluster Tree Topology