Energy-Balanced Edge-Based Clustering Algorithm for Wireless Sensor Networks

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In employing clustering algorithm in multi-hop data transmission model, Hot-spot problem arises due to uneven energy consumption among cluster heads. Unequal clustering mechanism balances energy consumption among inter cluster communications but not in intra-cluster communication and will introduce several other problems into the network. To overcome these problems, an Energy-balanced Edge-based Clustering Algorithm (EECA) is proposed for wireless sensor networks. The primary goal of the proposed algorithm is to avoid hot-spot problem with uniform energy dissipation among cluster heads. For this, it creates unequal size clusters across different levels, which promotes invariable energy dissipation among cluster heads across different levels. Data communication is one of the heavy energy consuming operations observed in sensor networks. To balance network load among different data forwarding routes, a multi-hop routing mechanism is proposed. In this model, source node chooses a relay cluster head which has forwarded less number of data packets and greater residual energy with minimum hop-count to base station in the downstream. Simulation results witness that the proposed unequal clustering algorithm avoids hot-spot problem with uniform energy dissipation among clusters and elevates network lifetime.

Keywords : Edge-Base Station, Energy-Balanced, Network Lifetime, Unequal Clustering Mechanism, Wireless Sensor Network.

1. INTRODUCTION

Wireless sensor networks are distributed collection of small embedded devices, each with sensing, computation and communication capabilities. Sensor nodes are constrained in term of processing power, communication bandwidth, and storage space. Energy has been an important issue when designing any wireless sensor network application. Sensor nodes are often grouped to create individual disjoint sets called, Clusters. Clustering techniques actively support network scalability, resource sharing and efficient use of constrained network resources. Cluster formation is generally based on energy reserves of sensors and sensor’s proximity to the Cluster Head. Clustering is one of the prominent techniques to save energy consumption in wireless sensor networks. Clustering schemes offer reduced communication overheads, efficient resource allocation with low interference among sensor nodes [2].

Wireless sensor networks are very large scale networks where clustering can simplify the multi-hop route discovery process compared to flat, location based and other non-clustering methods. Although formation and maintenance of clusters introduces addition cost of control messages, clustering structure of net-
7. CONCLUSIONS

In multi-hop data routing model, hot-spot problem arises when employing clustering mechanism. Unequal clustering methodology has been proposed to overcome hot-spot problem in the literature. But, it generates huge number of clusters in various sizes at different
levels to achieve it. Though unequal clustering avoids hot-spot problem, it increases hop-count between source and destination, which leads to energy wastage. Also, irregular size clusters causes imbalance in energy dissipation among sensor nodes and degrades network lifetime. To overcome these issues a novel Energy-efficient clustering algorithm is proposed for edge-based wireless sensor networks in this paper. It creates unequal clusters at each level, where cluster size rises as the distance with base station increases. This constructs small size clusters near base station to preserve some energy for inter-cluster communication. This balances energy consumption among cluster heads and avoids hot-spot problem. Also, the proposed inter cluster multi-hop routing protocol distributes network load uniformly among all data forwarding routes. The intelligent relay node selection process assists cluster heads to choose a relay node to forward data towards base station. Simulation results prove that the proposed clustering technique enables hot-spot free network by balancing energy consumption among uniformly distributed cluster heads. The proposed multi-hop routing scheme shares network load uniformly among all data forwarding routes and prolongs network lifetime.

REFERENCES


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