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Abstract (Doctor)

Title of Thesis	An Energy-Efficient Adaptive Group Clustering in Wireless Sensor Networks for Mobile Groups

Approx. 800 words

A large number of sensor nodes create a wireless sensor network. It has components such as sensing, wireless communication, and data processing. Wireless sensor networks (WSNs) have many applications, for example exploration, wildlife protection, and health care application. Other applications that consider group mobility are search and rescue activity and the evacuation of people in a natural disaster. Regarding these applications, a WSN needs to be designed considering mobile nodes. The main goal of mobile WSNs deployed in a network area is to deliver more data from a mobile sensor node to a base station (BS) with the limitation of energy consumption. Then, the data will be analyzed at the BS. Data collection and energy consumption are important factors in designing and determining mobile WSNs. To effectively perform these tasks, this thesis presents several protocols based on a clustering system to tackle such issues.

Firstly, this thesis proposes a protocol which supports handover procedure with entity mobility, i.e., Mobile Node Low-Energy Adaptive Protocol (MN-LEACH). The protocol reduces the distance between cluster head and cluster member when the cluster member moves out from the current cluster head. MN-LEACH outperforms LEACH in terms of number of alive nodes and the energy dissipation per round. Then, to support the group movement and to achieve an energy-efficient protocol, it proposes another protocol, namely a Group mobility based Clustering (GC) scheme. GC schemes apply a group as a cluster which consists of group leader and group member. This protocol reduces the control overhead in the setup phase of a clustering system by introducing a concept of group leader and group member. In this scheme, the communication with cluster-head is only done by the group leader to save the energy consumption. Based on the simulation results, GC Single increases the lifetime of the networks and the number of packets received at a base station, compared with LEACH and MN-LEACH. From this viewpoint, we study the characteristic of sensor nodes in mobile environment with entity mobility (MN-LEACH) and group mobility (GC Scheme).

We then tackle some problems of the existing protocols on the design of mobile group WSNs such as high control packet and energy consumption as well as more frequent topology changes that reduce

network lifetime and the number of data items received at the base station. To address these problems and to respond to the challenge of group mobility based scheme, this thesis proposes a new protocol considering group mobility together with assigning an appropriate role to nodes, i.e. an Energy-efficient Mobile Group Clustering (EMGC) protocol for mobile WSNs. It makes a fixed group formation of all sensor nodes to evaluate clearly the effectiveness of the scheme. The sensor nodes are divided into three categories, i.e., a cluster head, a group leader and a group member node. In our cluster formation and group handover scheme, group leaders and cluster heads do most of the communications to save on energy consumption during which group members are placed in the sleep condition. This scheme will reduce the number of control packets and frequent topology changes in the networks. n addition, EMGC provides a group handover procedure when the group of sensor nodes moves out from the current cluster and gets closer to another cluster. EMGC protocol outperforms MN-LEACH, GMAC, MBC protocols in terms of energy dissipation and the number of data items received at a base station.

In mobile group environments, there is a possible event occurring in a mobile group environment where some mobile nodes in the same mobile group move to other mobile groups. This becomes a challenging problem in EMGC protocol because EMGC uses a fixed group formation which causes a longer distance between GL and GM and requires more transmission power. Furthermore, this protocol fails to maintain the number of data delivery and network lifetime as increasing the number of groups also increases the number of control packets and collisions between GL and GM. To address these problems, this thesis proposes a novel group formation scheme which is integrated with an EMGC protocol, i.e. an Adaptive group formation with EMGC (AgEMGC) for mobile group WSNs. It uses a link expiration time and residual energy to form a stable link in a group. It also has a group merging procedure to decrease the number of groups. Furthermore, it develops two additional functions for the protocol, i.e., GL rotation and a stay connection procedure to diminish energy consumption in the network. AgEMGC protocol outperforms MBC, EMGCwoh, and EMGC protocols in terms of data delivery, network lifetime, and energy dissipation per round with various group change probabilities and percentages of groups.