Fuzzy Logic-Based Mobility Metric Clustering Algorithm for MANETs

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ABSTRACT

Mobile ad-hoc network, (MANET) is a collection of wireless mobile nodes dynamically forming a temporary communication network without using any existing infrastructure or centralized administration. To reduce routing overhead, computational complexity and overcome the problem of low bandwidth utilization, MANET is divided into several clusters. The authors propose a fuzzy logic based mobility metric for MANET that had been utilized as the basis of cluster formation in the algorithm viz., FUZZY CLUSTERING. This algorithm leads to more stable cluster formation compared to the existing MOBIC algorithm as evidenced by significant reduction in the number of clusterhead changes. As the frequency of cluster reorganization is a significant attribute, the proposed algorithm is expected to yield improved performance for MANETs.

Keywords: Cluster, Fuzzy Clustering, Fuzzy Logic, MANET, Mobility Metric

INTRODUCTION

MANET (Mobile Ad hoc NETwork) is a collection of wireless mobile nodes dynamically forming a temporary communication network without the use of any existing infrastructure or centralized administration (Aggelou, 2005). With the increase in size of the networks, routing table could grow to an immense size resulting in low bandwidth utilization with high load due to longer source routes and thus, large byte overhead (Johansson et al., 1999), which raise scalability issue. Therefore, clustering algorithms are proposed in MANETs to address scalability issue by providing a hierarchical network structure for routing.

The MANET is divided into several clusters. From each cluster certain nodes are elected to be clusterheads. The clusterhead collects information signaling, message, etc. and allocates...
resources within its cluster and communicates with other clusterheads. By partitioning the network into clusters of nodes and performing hierarchical routing, scalability is improved since a reduced number of mobile nodes participate in the routing algorithm, hence a low routing-related control overhead. Clustering perform reduced amount of routing computation as local movement of member nodes is now handled locally. Clustering overcomes mobility of nodes by adjusting cluster size according to network stability and makes dynamic topology to appear less dynamic by considering cluster stability when they form (McDonald & Znati, 1999). Hence, network state information is less variable (Perkins, 2001). This minimizes link breakage and packet loss.

Clustering algorithm in MANETs should be able to maintain its cluster structure as stable as possible while topology changes. Since mobility is the main cause for the changes in clusterheads and cluster memberships, (i.e., stability of cluster) it is logical to have mobility metric as a basis of cluster formation and clusterhead selection.

In this paper, a mobility metric is presented that is based on fuzzy logic considering the successive measurements of received power at any node from its neighbors (Korotkich & Dimitrov, 2002). This metric neither needs the availability of any absolute location information at a node nor the availability of velocity information at every node. The new mobility metric is therefore used as the basis of cluster formation of our proposed algorithm, FUZZY_CLUSTERING.

Our simulation work show that the proposed algorithm yields certain improved response over the existing MOBIC algorithm (Basu, Khan, & Little, 2001), e.g.,

- 39.27% reduction in average number of clusterhead changes
- 20.84% reduction in time after which probability of reclustering is minimal

**LITERATURE SURVEY**

A number of clustering algorithms have been proposed in literature such as Linked Cluster Algorithm (LCA) (Baker & Ephremides, 1981), Lowest-ID Algorithm (L-ID) (Ephremides et al., 1987), Maximum Connectivity Clustering (MCC) (Parekh, 1994), Least Clusterhead Change Algorithm (LCC) (Chiang et al., 1997), Distributed Clustering Algorithm (DCA) (Basagni, 1991), MOBIC (Basu, Khan, & Little, 2001) and MobDHop (Er & Seah, 2004). LCA (Baker & Ephremides, 1981; Ephremides et al., 1987) organizes nodes into clusters on the basis of node proximity. Parekh suggested MCC in which the clusterhead election is based on degree of connectivity instead of node ID (Parekh, 1994). LCC (Chiang et al., 1997) is designed to minimize clusterhead changes. Lowest ID algorithm (Ephremides et al., 1987)) is generalized to a weight based clustering technique, referred to as DCA (Basagni, 1991).

Location Aided Hierarchical Cluster Routing (LHCR) (Yang & Chou, 2009) divides the nodes of the network into various hierarchical clusters recursively, based on the electricity amount and ID (Identification). Electricity level consideration prevents lowest ID nodes selected as clusterheads from failing due to electrical overload.

Weight Based Adaptive Cluster Algorithm (WBACA) (Dhurandher & Singh, 2007) based on the transmission rate, mobility, and battery power of nodes chooses the optimized number of clusterheads. But it requires many parameters and large ‘frozen time’ for calculation.

Weight Based Adaptive Clustering for Large Scale Heterogeneous MANET (WACHM) (Wang et al., 2007) finds the optimal number of clusterheads, optimal hops and elects clusterhead based on degree-difference, battery power, average link stability and dependency probability.

Fuzzy based clustering is proposed in literature (Zhao & Wang, 2004; Adabi et al.,
Throughput-Efficient Spectrum Access in Cognitive Radio Networks: A Coalitional Game Theoretic Approach


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