IJCSMS International Journal of Computer Science and Management Studies, Vol. 12, Issue 02, April 2012
ISSN (Online): 2231-5268
www.ijcsms.com

An Adaptive Fuzzy System in Large Scale Mobile Ad Hoc Networks

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Abstract

Multicast protocols in MANETs must consider control overhead for maintenance, energy efficiency of nodes and routing trees managements to frequent changes of network topology. Now-a-days Multicast protocols extended with Cluster based approach. Cluster based multicast tree formation is still research issues. The tree reconstruction of cluster-based multicast routing protocol will take place if any link of the trees has malfunction or the nodes move out of the link, therefore, its robust performance is unsatisfactory. The mobility of nodes will always increase the communication delay because of re-clustering and cluster head selections. For this issue we proposed the new scheme Adaptive Fuzzy System (AFS), its fuzzy based clustering and predicting the next cluster head (CH) based their location updates with clustered group. A new location management scheme is proposed to handle the mobility of cluster members, based on a hybrid strategy that includes location updating and location prediction. In a clustered zone predicts movement of members and CH based on Kalman filtering of previously received updates and based on location updates CH will selected. Here location managements will leads to reduce cluster head selections. We used ns2 for our AFS.We present simulation results that demonstrate a significant reduce the communication delay over the traditional cluster based MANETs deployments.

Keywords: *Fuzzy Clustering, MANET, Kalman Filter, Location Management.*

1. Introduction

The recent advances in wireless and' mobile technology is evident from the fact of widespread usage of mobile and wireless devices such as laptops, paImtops, personal digital assistants etc. The emergence of group oriented real-time applications such as IP telephonic, video conferencing, and video gaming has generated the demand for group communication support in wireless and mobile networks. The parameters such as delay, throughput, jitter, packet loss etc, are very important in these aplications [1].
A mobile ad-hoc network (MANET) is a multi hop wireless network, where nodes communicate with each other without any pre-deployed infrastructure. With the absence of pre-established infrastructure (e.g., no router, no access point, etc.), two nodes communicate with one another in a peer-to-peer fashion. Two nodes communicate directly if they are in the transmission range of each other. Otherwise, nodes can communicate via a multi-hop route with the cooperation of other nodes. MANET is self-creating, self-organizing and self-administrating. Examples include battlefield scenarios, disaster relief and short-term scenarios such as public events [2]. The frequent changes in network topology, scarce bandwidth, limited storage and processing capability of MANETs have opened up several challenges for computer network researchers. One of the important challenges is to provide a support for real-time multicast communication [1].

Now-a-days Multicast protocols extended with Cluster based approach. Based on the topology the existed ad hoc multicast routing protocols are classified into two categories i.tree based ii.mesh based. The tree based routing scheme has only one path between the source to receiver. MAODV, AMRIS, AM Route are the best examples for the tree based scheme. But, the mesh-based routing scheme has multiple redundant paths between the sources to receivers. ODMRP, CAMP is the typical examples of mesh-based scheme [2]. Both are giving some salient features to mobile ad hoc network. In earlier days multicast routing protocols are designed with the multiple unicast system [9]. After that it had extended as multicast system, which has only one source in a multicast group[3]. Recently, some prominent researchers have been proposed

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the cluster based multicast routing scheme for ad hoc networks. By this admissible work we can share different kinds of services or applications simultaneously in the multicast group.

Problems in Cluster-Based routing are the tree reconstruction of cluster-based multicast routing protocol will take place if any link of the trees has malfunction or the nodes move out of the link, therefore, its robust performance is unsatisfactory. So disconnection of one link may not affect the transformation of multicast packets. And another one is Cluster heads have high communication task, So Cluster head will failure due to lack of energy. However, the stability of the cluster heads is very important to the networks and non ideal cluster heads is possible to the "bottle-neck" of the networks [4]

The Kalman filter is the best possible (optimal) estimator for a large class of problems and a very effective and useful estimator for an even larger class. With a few conceptual tools, the Kalman filter is actually very easy to use. By using kalman filter we can predict the location updates within clustered groups, each CH gets their neighbors locations.CH also exchange their position to members.CH keeps tracks of nodes position it will leads to predicts the new cluster head based on mobility.CH also predict neighbors' future directions.

Based on the above analysis, the paper makes proper improvement to Cluster-based multicast routing protocol, and proposes the Adaptive Fuzzy Based Routing (AFMR) in large scale mobile ad hoc networks. Design aspects of our system are Protocol Model, Cluster Formation, Location updates by Kalman Filter, Multicast Transmission and Simulation and results.

2. Related Works

Shekhar H M P, Arun Kumar M A, and K S Ramanatha have presented an efficient Mobile Agents Aided Multicast Routing (MAMR) protocol which overcomes these limitations. The protocol was a hybrid protocol where intelligent mobile agents can been integrated with existing on-demand multicast routing protocols such as Multicast Ad Hoc On-demand Distance Vector (MAODV) routing protocol, On demand Multicast Routing Protocol (ODMRP) routing protocol and others[1]. ZHAO Chun-Xiao and WANG Guang- Xing investigated the use of fuzzy control techniques. For each metric, a fuzzy membership function was defined to predict a more stable link. A fuzzy-inference rule base was implemented to generate the fuzzy cost of each link. A degree clustering algorithm based on a mobility prediction scheme was proposed in a scalable manner [2].

R. Pandi Selvam and V.Palanisamy have designed a cluster-based multi source multicast routing protocol with new cluster head election, path construction and maintenance techniques. They compute the maximum performance of proposed routing protocol in various environments, and also it compared with Multicast Ad-hoc On-Demand Distance Vector (MAODV) and On-Demand Multicast Routing Protocol (ODMRP) to prove the performance of delivery ratio, control overhead and forwarding efficiency [3]. XUE-MEI SUN, WEN-JU LIU, ZHI-QIANG ZHANG and YOU ZHAO have developed a Cluster-based On Demand Multicast Routing Protocol (CODMRP) to the lack of extension of flat multicast routing protocols in Ad Hoc networks of large scale. [4].

K. Venkata Subbaiah and Dr. M.M. Naidu have proposed a cluster head election scheme using fuzzy logic system (FLS) for mobile ad hoc wireless networks. They used three descriptors: distance of a node to the cluster centroid, its remaining battery capacity, and its degree of mobility. The linguistic knowledge of cluster head election based on these three descriptors is obtained from a group of network experts. [5]. Bey-Ling Su, Ming-Shi Wang and Yueh-Ming Huang proposed the fuzzy modified AODV (FMAR) multicast routing protocol to select two comparably stable routes by computing dynamic route lifetime for multicast routing or layered video streaming[6].

Jong-Myoung Kim, Seon-Ho Park, Young-Ju Han and Tai-Myoung Chung presented a cluster head election mechanism–CHEF. They evaluated CHEF compare with LEACH using the mat lab. The simulation results show that CHEF is 22.7% more efficient than LEACH. This is because the energy and local distance is considered in electing cluster heads. [7]. Roberto Carlos Hincapi, Blanca Alicia Correa and Laura Ospina investigated a survey on clustering techniques for MANET. Some preliminary concepts that form the basis for the development of clustering algorithms are introduced. These related issues have to do with the network topology, routing schemes, graph partitioning and mobility algorithms [8].

Rajendra V. Boppana and Xu Su presented quantitative evaluations of false positives in monitoring-based intrusion detection for ad hoc networks. They showed that, even for a simple three node configuration, an actual ad hoc network suffers from high false positives. They

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validated the experimental results using discrete-time Markov chains and probabilistic analysis [9]. Rui Huang and Gergely V. Z Aruba proposed a mechanism that allows non-GPS-equipped nodes in the network to derive their approximated locations from a limited number of GPS-equipped nodes. In their method, all nodes periodically broadcast their estimated location, in term of a compressed particle filter distribution. Non-GPS nodes estimate the distance to their neighbors by measuring the received signal strength of incoming messages. A particle filter is then used to estimate the approximated location, along with a measure of confidence, from the sequence of distance estimates [10].

Zhaowen Xing, Le Grunewald and K.K. Phang presented a robust weighted clustering algorithm, called PMW (Power, Mobility and Workload), to form and maintain more stable clusters. In PMW, the weight of each node is calculated by its power, mobility and workload, which can be easily collected and computed locally and cover the major factors that cause re-clustering. Clustering overhead of PMW is analyzed [11]. J. D. Mallapur, S. S. Manvi and D. H. Rao have proposed a scheme for constructing a multicast tree based on a spanning tree by employing a fuzzy controller. Fuzzy controller uses three fuzzy input parameters namely, link bandwidth, link delay and link reliability for the construction of multicast spanning tree [12].

Byung-Jae Kwak, Nah-Oak Song and Leonard E. Miller proposed measure is consistent because it has a linear relationship to the rate at which links are established or broken for a wide range of mobility scenarios, where a scenario consists of the choice of mobility model, the physical dimensions of the network, the number of nodes. [13]. Dewan Tanvir Ahmed discussed different multicasting protocols, their deployment issues and provides some guidelines for the researchers in this field [14]. Shahram Nourizadeh, Y.Q. Song and J.P. Thomesse proposed a decentralized algorithm to organize an ad hoc sensor network into clusters by using Fuzzy Logic. Each sensor uses a Fuzzy decision making process to find the best Cluster Head. Simulation showed that this protocol is able to dynamically adapt to network mobility and also shows that with fuzzy logic we have stable clusters and so a cluster head have greater lifetime [15].

3. Protocol Model

We propose new Adaptive fuzzy multicast routing (AFMR) is solve reclustering delay in MANETs. Our proposed protocol is three phases; cluster based multicast tree formation, localized clustering and data transfer. The cluster formation is by the calculating the weighted factor of each node has to become the cluster-head by considering two fuzzy memberships like its remaining battery capacity, and its degree of mobility node with respect to the entire cluster.

The nodes send data to the respective cluster -heads, which in turn compresses the aggregated data and transmits it to the group members. For a MANET we make the following assumptions:

- Due to node mobility cluster tree formation and cluster head selection is consider heavy control overhead.
- Location based cluster evaluation is considering for future multicast routing.

In our protocol approach, Considering MANET'S are meant to be deployed over a geographical area with the main purpose of sensing and gathering information, we assume that nodes have minimal mobility, thus sending the location information during the initial setup phase is sufficient.

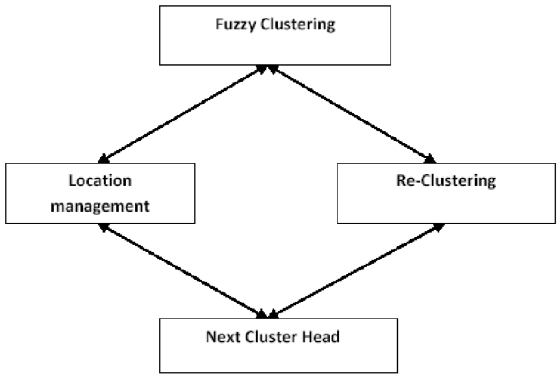

Fig. 1 AFMR Protocol Architecture

4. Fuzzy Cluster Formation

We evaluate the cluster formation is based on the following two fuzzy membership functions:

- Node Remaining Energy - energy level available in each node, designated by the fuzzy variable energy
- Node Mobility - a value which classifies the nodes based on how central the node is to the cluster, designated by the fuzzy variable mobility.

The linguistic variables used to represent the node energy and node concentration, are divided into three levels: low, medium and high, respectively, and there are three levels to represent the node mobility: close, adequate and far, respectively. The outcome to represent the node cluster-head election chance was divided into six levels: small, very small, rather medium, medium, large, and very

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large. The fuzzy rule base currently includes rules like the following: if the energy is high and the centrality is close then the node's cluster-head election chance is very large. All the nodes are compared on the basis of chances and the node with the maximum chance is then elected as the cluster-head. Each node in the cluster associates itself to the cluster-head and starts transmitting data.

To do this, we averaged the centroids of all the responses for each rule and used this average in place of the rule consequent centroid. Doing this leads to rules that have the following form:
IF remaining battery capacity (w1) of node F1 1, and its degree of mobility (x3) is Fl 3, THEN the possibility that this node will be elected as a cluster head (ch) is cl avg, where l == 1, 2, 3...9.

$$C^{1} = \frac{\sum^{6} i=1\ \omega_i^{\ l}\ c_i^{\ l}}{\sum^{6} i=1\ \omega_i^{\ l}}$$

5. Location Updates by Kalman Filter

In general, location management may follow two strategies: location updating and location prediction. Location updating is a passive strategy in which each CH periodically broadcasts its position to the neighboring nodes. Location prediction is a dynamic strategy in which cluster members proactively estimate the location of their neighboring CH. In this case, the tracking efficiency depends on the accuracy of the mobility model and on the efficiency of the prediction algorithm. We use Voronoi diagrams to limit the scope of CH initiated location updates. The Voronoi diagram of a set of discrete sites partitions the plane into a set of convex polygons such that all points inside a polygon are closest to only one site. For their properties and ease of computation, Voronoi diagrams have been previously applied to the area of MANTs.

The Kalman filter provides a computationally efficient set of recursive equations to estimate the state of such process, and can be proved to be the optimal filter in the minimum square sense. The joint use of Kalman filter at the cluster head and members sides enables reducing the number of necessary location updates. In fact, the filter is used to estimate the position at the actor based on measurements, which is a common practice in robotics, and to predict the position of the CH (i) at the members, thus, reducing the message exchange. The position of CH can be estimated and predicted at the members in its Voronoi cell, based on the measurements ziK taken at the actor and broadcast by the actor. At step k, each member's m in i's Voronoi cell updates the state (that represents position and velocity of the ch) based on the equations.
The position observed by the actor at step k is related to the state by the measurement equation

$$\mathbf{z_i^k = Hx_i^k + Cv_i^k}, \qquad (2)$$

Where represents the observed position of the actor at step k, and where H = [I ,0], C =B. I = [1 0; 0 1]. B = [0 / B];

5.1. LOCATION UPDATES IN CLUSTERED GROUPS

By using kalman filter we can predict the location updates within clustered groups, each CH gets their neighbors locations.CH also exchange their position to members.CH keeps tracks of nodes position it will leads to predicts the new cluster head based on mobility.CH also predict neighbors' future directions. It will leads to fuzzy membership function, here it reduces re-clustering timing.

5.2. CH TO CH GROUPS

Cluster head to cluster head scenario location management scheme updating position of neighbors' nodes will exchange each other. Like if any node moving out of clustered groups.CH will predict the future direction and exchange to direction based CH.While applying the new CH selection this information will leads efficient fuzzy membership formation. In networks with mobile nodes and multiple recipients, however, it depends on the ability of location management schemes to efficiently provide relevant nodes with the position of mobile nodes at any time. Each member will thus expect to receive location updates from the actor it is dominated by. With respect to delay, the energy consumption for location updates is drastically reduced.

6. PERFORMANCE EVALUATION

As far as multicast communication is concerned, implement the clustering and location management scheme described in Section 3. The MAC layer is based on IEEE 802.11. The monitored area is a 500 m 500 m square, with 50 randomly deployed nodes. The maximum transmission range of nodes is set to 50 m and the bandwidth to 250 Kbit/s. We perform terminating simulations that last 100 s, average over different random topologies. The mobility experiment consisted of 5 traffic sources and 20 receivers chosen randomly. Each source transmitted 10 Kbps and thus the overall network load was 50 Kbps.

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6.1. METRICS

We use the following metrics in evaluating the performance of the different multicast routing protocols.

Packet delivery ratio is computed as the ratio of total number of unique packets received by the receivers to the total number of packets transmitted by all sources times the number of receivers.Routing overhead is the ratio between the numbers of control bytes transmitted to the number of data bytes received. In AMFR, control bytes account for Join-Query and Join-Table packets.

Fig. 2

Comparing AFMR to CBRP, we notice that at lower speeds the difference in packet delivery ratio is between 5% and 7%.However,at higher speeds the gap in packet delivery ratio starts widening.

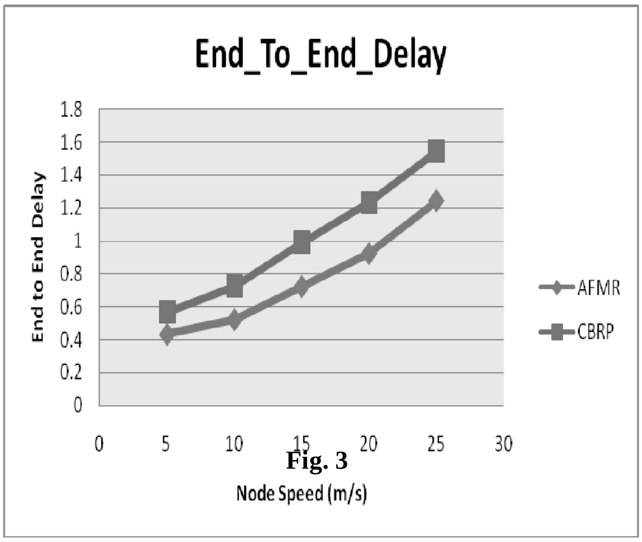

Fig. 3

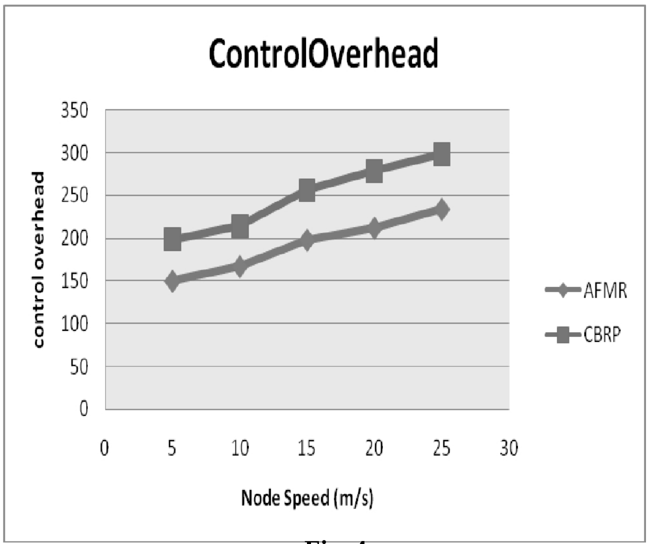

Fig. 4

Figure 3 plots control overhead per data byte transferred as a function of mobility. Note that AFMR overhead does not change with mobility as only data header packets contribute to overhead.

7. Conclusions

In this paper, we reported on simulation-based experiments evaluating two different approaches clustering to multicast communication in mobile ad hoc networks (MANETs), namely AFMR and CBRP. One of the chief contributions of this work is our objective analysis of these two multicast routing protocol categories in order to characterize their behavior under a wide range of MANET mobility. We present a cluster head election scheme using fuzzy logic system for mobile ad hoc wireless networks. Three descriptors are used its remaining battery capacity, and its degree of mobility. Kalman filter used to predict the future clusters and cluster heads, its increasing the performance of clustering phases and reduce the re clustering delay and control packets. One possible solution would be to develop specialized multicast solutions for each type of network and the means for integrating those solutions. We believe that an adaptive, integrated approach to routing may be the best means to tackle this problem. In this approach nodes can dynamically switch routing mechanisms based on their perception of the network conditions. The future direction is focus on enhancing fuzzy clusters delay in large scale networks.

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www.ijcsms.com

References

[1[Shekhar H M P, Arun Kumar M A, and K S Ramanatha, (2005) "Mobile agents aided multicast routing in mobile ad hoc networks" Advanced Communication Technology, 2005, ICACT 2005.

[2] ZHAO Chun-Xiao and WANG Guang-Xing, (2004) "Fuzzy-Control-Based Clustering Strategy in MANET" Proceedings of the 5th World Congress on Intelligent Control and Automation, June 15-19, 2004,

[3] ZHAO Chun-Xiao and WANG Guang-Xing, (2004) "Fuzzy-Control-Based Clustering Strategy in MANET" Proceedings of the 5th World Congress on Intelligent Control and Automation, June 15-19, 2004

[4] R. Pandi Selvam and V.Palanisamy, (2011) "AN EFFICIENT CLUSTER BASED APPROACH FOR MULTI-SOURCE MULTICAST ROUTING PROTOCOL IN MOBILE AD HOC NETWORKS" International Journal of Computer Networks & Communications (IJCNC) Vol.3, No.1, January 2011

[5] XUE-MEI SUN, WEN-JU LIU, ZHI-QIANG ZHANG and YOU ZHAO,(2006) "CODMRP: Cluster-based On Demand Multicast Routing Protocol "Wireless Communications, Networking and Mobile Computing, 2006. WiCOM 2006

[6] K. Venkata Subbaiah and Dr. M.M. Naidu, (2010) "Cluster head Election for CGSR Routing Protocol Using Fuzzy Logic Controller for Mobile Ad Hoc Network" Int. J. of Advanced Networking and Applications 246 Volume: 01, Issue: 04, Pages: 246-251 (2010)

[7] Bey-Ling Su, Ming-Shi Wang and Yueh-Ming Huang,(2008) "Fuzzy logic weighted multi-criteria of dynamic route lifetime for reliable multicast routing in ad hoc networks" Expert Systems with Applications: An International Journal Volume 35 Issue 1-2, July, 2008

[8] Shahram Nourizadeh, Y.Q. Song and J.P. Thomesse, (2007) "A Location-Unaware Distributed Clustering Algorithm for Mobile Wireless Networks Using Fuzzy Logic"FET2007 Toulouse – France

[9] Dewan Tanvir Ahmed, (2005) "Multicasting in Ad Hoc Networks" CSI5140F Wireless Ad Hoc Networking Professor Ivan Stojmenovic Ottawa, Ontario, Canada, Fall 2005

[10] Byung-Jae Kwak, Nah-Oak Song and Leonard E. Miller, (2003)" A Mobility Measure for Mobile Ad-Hoc Networks" Communications Letters, IEEE Issue Date: Aug. 2003