

A Novel Routing Protocol based on Efficiency Division Factor

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Abstract— Mobile Ad-hoc Network (MANET) network is very dynamics in nature and hence provides many challenge to routing protocol. MANETs network have two different topologies: f hierarchical architecture and flat. In a flat network design, each node has essentially the same job and is adequate for small networks and is easy to design, implement and maintain as long as the network stays the same. When the network become large in number of nodes, a flat network becomes unmanageable and undesirable because it provides delay and jitter and put makes the network unstable. So hierarchical network becomes a better choice. In a hierarchical network, the nodes are divided into clusters. Each cluster have a cluster head (CH) which is mainly responsible for the route calculation and communication with in the cluster and outside the cluster. This work proposes a novel routing protocol for clustering that divides the larger network into small clusters. The scheme, used to choose the cluster head (CH) is based on efficiency division factor (EDF).

Index Terms— MANET, EDF, CH, CM, WD, node, Gateway node,

1 INTRODUCTION

In a large infrastructure less mobile wireless mobile network, flat routing schemes produce flooding of information that increases overheads in the network [6]. In addition, network has different types of nodes in the network. Nodes may have different and variable amount of resources, and this diversity create their different roles and function inside the network. Nodes having more efficiency and communication capabilities and powerful batteries are more suitable for supporting the network functions. Cluster-based routing is a good solution to address nodes diversity, and to limit the amount of overheads inside the network. The basic idea behind clustering is to group the network nodes into a number of overlapping clusters [21]. This enables the aggregation of the routing information, and consequently increases the routing algorithms scalability. Clustering makes possible a hierarchical routing in which paths are recorded between clusters (instead of between nodes); this increases the routes lifetime, thus decreasing the amount of routing control overhead [7,21]. Clusters are very small group of nodes having one central authority called Cluster Head (CH) and cluster member (CM). The choice of group formation may be arbitrary. This work propose a hierarchical Ad-hoc on demand distance Vector (HAODV) routing protocol which tries to find out the most capable node in the network as cluster head (CH) based on the efficiency division factor (EDF) of a node.

2 RELATED WORK

Routing is one very important challenge in MANET. It has three major goals[16, 17, 18,19].

- Provides the maximum reliability by selecting alternatives route
- Provide the path with least cost in the network by minimizing the actual length between source and destination through the least number of hops for network traffic hence less delay and jitter
- Provide best possible response time and throughput form the nodes.

Routing can be categories as Proactive and reactive. In proactive routing, routers attempts to maintain the routes all the time within the network. On the other side, in reactive protocol, the router maintains the route only on demand.

In infrastructure less ad-hoc network, cluster based routing [8] is very convenient.

Clustering is defined as dividing the larger network into small network. This virtual assembly of nodes is grouped together regarding their relative transmission range proximity to each other that allows them to establish a two way link. The size of the clusters determines the control architectures as single-hop clustering and multi-hop clustering. In single-hop clustering every member node is only 1-hop away from the cluster head (CH). Thus all the member nodes remain at most two hops distance away from each other within the cluster. In multi-hop clustering, the restriction of an immediate proximity to member nodes from the cluster head is removed, allowing them to be present in serial k-hop distance to form a cluster (Angione et al., 2007). Each node is identified with an ID number. Each node bearing equal responsibility in its role as a router for forwarding packets to every other node in a flat architecture. This type of arrangement is prone to message flooding which offers better routing efficiency but significantly reduce the Medium Access Control layer efficacy (Perkins, 2008). Clustering schemes, improved spatial reuse, scalability, and throughput of the network. At the network layer, clustering helps to improve routing through reduction of the routing table size and a decrease in transmission overhead following topological changes (Inn & Winston, 2004). Clustering schemes generally utilize three types of nodes cluster head (CH), Cluster Member (CM) and gateway node which are chosen to assume different roles according to specific criteria [20, 21].

3 Proposed Research Methodology

Existing clustering scheme available in the literature [18, 19, 20] concentrates on clustering the larger network by dividing into small network however fail to take care efficient node in the cluster while electing a Cluster Head (CH), cluster member. There may cases when a node itself advertises itself as a CH

node and take care of its efficiency. Several scheme check for the efficiency of all nodes while forming clusters however it will waste bandwidth of the network. Rather, efficient checking of Efficiency Division Factor (EDF) for only those nodes that claim to be Cluster Head would be useful. The Primary aim of this work is to propose and develop a routing algorithm which is able to divide the large network into small clusters and facilitate to reinforce the performance of mobile ad hoc network by electing suitable cluster head (CH) and cluster member. Proposed routing algorithm uses efficiency division factor (EDF) for electing a cluster head (CH) and further that cluster head allocate loads to its cluster members according to their efficiency.

3.1 Proposed Efficiency Division Factor (EDF)

All the nodes in the cluster send the performance table (as shown in Table 1) using CAODV protocol to the neighbor node.

TABLE 1
Parameters For Calculating Edf Of A Node

Node ID	Power Back Up (%BB)	Resources (R)	Service Type	Processing Speed (%S)
1.	80	1	*abc	90
2.	30	3	*abc	70
3.	40	2	*abc	38
4.	90	6	*abc	68
5.	85	5	#xyz	80
6.	55	3	*xyz	40
7.	68	1	#pqr	50
8.	72	4	=pqr	30

The resources in percentage calculated as from table

$$\% Ri = Ri * 100 / (\sum_{j=1}^M Ri) \quad (1)$$

Where M is the set of nodes of same type services

Average efficiency division factor (EDF) can be calculated as below

$$\% \text{ Average EDF} = \%R + \%S + \%BB / 3 \quad (2)$$

From the equations (1, 2) the efficiency division factor (shown in Table II) can be calculated, in which service type shows the services provided by the node. On the basis of highest efficiency division factor (EDF), a node claim as cluster Head (CH) and distribute the load in the cluster as shown in table-II and Fig.2

TABLE 2
Efficiency Division Factor

Node ID	(%BB)	Resources (R)	Service Type	P.S (%)	(% R)	%EDF
1.	80	1	*abc	90	8.33	59.44
2.	30	3	*abc	70	25	41.66
3.	40	2	*abc	38	16.67	31.55
4.	90	6	*abc	68	50	69.33
5.	85	5	#xyz	80	62.5	75.83
6.	55	3	#xyz	40	37.5	44.16
7.	68	1	#pqr	50	20	46
8.	72	4	=pqr	30	80	60.66

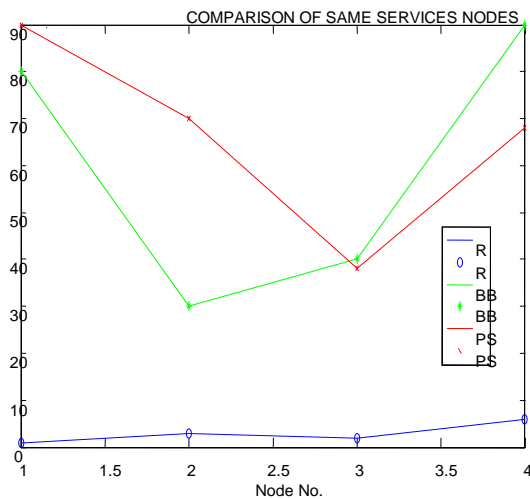


Fig 1. Comparison of Nodes of Same Services

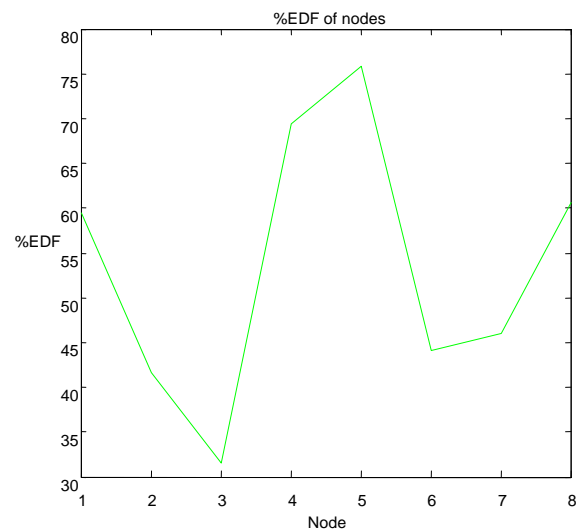


Fig 2. %EDF for Same Services Node

3.2 Load Allocation based on Work Division

Factor (WDF)

After computing EDF (Table 2) , cluster head (CH) may divide the work to particular nodes according to Work Division Factor (WDF) shown in table 3. For example if WDF for node 5 is 76% of the work for the service #xyz then for node 4 it is 69 for service*abc and for the service =pqr node 8 it is 60% of the work n and so. CH has the authority to distribute the work among the nodes of same services.

TABLE 3
 Work Division Factor

Node ID	% EDF	%WDF
1	59.44	59
2	41.66	42
3	31.55	32
4	69.33	69
5	75.83	76

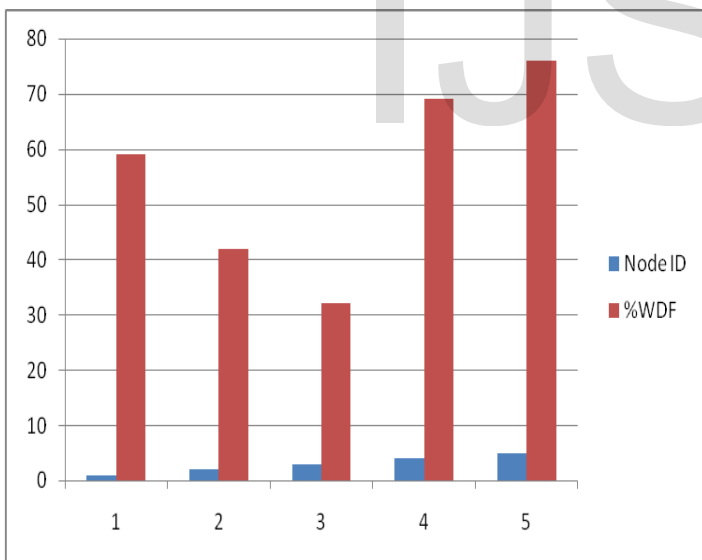


Fig 3. Load division on behalf of WDF

4 Proposed Algorithm design consideration

Proposed approach uses Efficiency Division Factor as a basic metric for selecting its cluster head (CH). EDF is the factor of capable node in the cluster. It is assumed that EDF equation-1 algorithm is running at each node. Every node uses this EDF algorithm to judge its efficiency and stores it in its routing table together with the EDF values of its entire 1- hop neighbors. Nodes share this information within the network.

Based on statics of each node i , $(EDFi)$ is calculated that is the total number of 1- hop neighbors of a node. A node having highest EDF claims to be a cluster head and broadcasts $claim()$ to all its neighbors. Each neighbor receiving this $claim()$ message can check their EDF values who claims to be a cluster head. If this value is found to be at some satisfactory level then the claiming node is asserted as a cluster head.

A cluster head needs to be reelected under the following situations:

- A cluster head fails
- The weight of a CH becomes less than some other node in the cluster
- Death of a CH ($RE=0$)
- A CH moves out of the cluster due to mobility

4.1 CH selection algorithm

N - Total number of nodes in the network

x, n - a node in the network

EDF –efficiency division factor of a node n

CH – i^{th} cluster head

$nnode$ – neighboring node

V_{th} $nnode$ –threshold value of neighboring node

CM – cluster member

RT – Routing Table

1. For every node $n \in N$, calculate EDF
2. For a node $x \in N$
 If $EDF = \max(EDF_1, EDF_2, EDF_3, \dots, EDF_n)$
 Then node x broadcast $claim()$ message
3. For all 1- hop neighbours receiving $claim()$
 Check V_{th} in RT of $nnode$ of x .
4. If $V_{th} \geq$ then check for CH
5. Else $V_{th} <$ then Check for CM
6. All nodes having CH or CM relation with claiming node x jointly declare x as a cluster head(CH)
7. This election is broadcasted in the network.

5 RESULT ANALYSIS

In Figure [2] node 5 is more efficient in comparison to other nodes and hence may claim for cluster Head. In the proposed method the node 1 utilized fully in the cluster, so it increases the overall working efficiency of complete Network. Because node 1 has very good efficiency so cluster head would not like to leave that node until and unless that node goes very far away. Even in the absence of itself, CH may assign as a cluster Head to node 1. Also Work can be distributed among nodes of same services according to fair load distribution by using table 3, request generated for completion of the some application of

service, then work should be divided according to the work division factor (WDF), shown in Figure 3, if we provided 41% of the work to node 2, and 32% of the work to node 3, and table 2 shows that node 2 is much efficient comparison to node 3 then node 2 will complete the assign work before the node 3 complete, in this situation cluster head has to wait for node 3 to complete its work. But with the fair allocation approach node 2 and node 3 may be allocated work according to their EDF and may submit the work within approximately same time, thus cluster head need not to wait for any other node. Thus overall performance of the network system will increase.

6. CONCLUSION AND FUTURE WORK

In this paper, we have proposed a novel routing algorithm to divide the larger network into clusters. Cluster head (CH) and cluster members (CM) are selected on the basis of Efficiency division factor (EDF). EDF of a node is calculated by the use of efficiency division formulae, which we have simulated in efficiency division table. It will be very helpful for dividing the work among the nodes by WDF. No such type of fair allocation work division approach is available in MANET. This approach will provide the new directions & dimensions in MANET for clustering. Future work will contribute designing of algorithm and optimization of efficiency table and more efficient algorithms for fair load distribution

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