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Energy Efficient and Node Mobility based Data Replication Algorithm for MANET

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Abstract *- A mobile ad-hoc network (MANET) is a self organizing, rapidly deployable network which consists of wireless nodes without infrastructure. All nodes in a MANET are capable of moving actively and can be connected dynamically. It is used in various applications like video conferencing, rescue operations, military applications, Disaster Management etc. So the data sharing in network play a vital role. In order to ensure the effective data sharing, the data replication is needed. The main aim of the work is to develop the efficient energy and node mobility based data replication algorithm to balance the Query delay, energy consumption and data availability in MANET. Due to the presence of the network partition, mobile nodes in one partition are not able to access the data hosted by nodes in the other partition. So the performance of data access is degraded. Existing methods aims at balancing trade-off between query delay and data availability. In proposed method we focus on balancing between the node's energy consumption, data availability and delay. By simulation results show that the proposed scheme achieves better performance than the existing methods.*

Keywords *- MANET, Data replication, Query delay, Network partition data availability and energy consumption.*

1. INTRODUCTION

A. Mobile Ad Hoc Networks (MANET)

A mobile ad hoc network (MANET) is a collection of autonomous wireless nodes that may move unpredictably, forming a temporary network without any fixed backbone infrastructure [1,2]. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology and delivering messages must be executed by the nodes it selves, i.e., routing functionality will be incorporated into mobile nodes. But data availability in MANET is reduced due to dynamic topology.

B. Data Replication

Data Replication is technique which enhances data availability by making copies of data items. Furthermore there are various issues arise in MANET which leads to problem in data replication. Replication allows better data sharing [3]. It is a key approach for achieving high availability. It is suitable to improve the response time of the access requests, to distribute the load of processing of these requests on several servers and to avoid the overload of the routes of communication to a unique server.

C. Issues concerning data replication for MANET databases

In addition to addressing issues such as data consistency and availability that exist in traditional databases, a data replication technique for MANET databases must also deal with the following additional issues arising from constraints imposed by their specific environments and applications As discussed in [4,5], these are the following issues concerning data replication:

• *Server power consumption*: Servers in MANET run on battery power. Power consumption of servers that provide database management system (DBMS) services to potentially many clients should be minimized. Servers with higher power availability are expected to perform more work than those that have lower power. If a server has low power remaining and if it is replicated with many frequently accessed data items (hot data), then frequent data access requests for these hot data might drain its power soon. Servers with no power remaining would not be able to provide any more services. The replication algorithm should thus replicate data items in such a way that the power consumption of servers is reduced, and is balanced among all servers in the system [6,7].

• *Server mobility*: Servers in MANET are mobile and the speed at which the network topology changes is higher than that in conventional mobile databases. Due to their mobility, servers might sometimes move to a place where they cannot be reached by other servers or clients. The replication technique should avoid replicating hot data items in such isolated servers.

• *Client mobility*: Clients that query the servers can be mobile. Clients sometimes send their transactions to the nearest servers to get a quicker response. The decision to replicate a data item in a particular server may be based on the access

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frequency of that data item on that server. Clients, after issuing their requests for data access to a server, might move to new positions after a certain interval of time, and they might send their query and update requests to the nearest servers from their new locations. Hence, the access frequencies must be dynamic in nature and the decision to replicate data items in appropriate servers must also be dynamic.

• *Client power*: Client machines also run using their battery power. Some clients like PDAs are more power restricted than servers. They are limited by the amount of energy they can use before their batteries need to be recharged. A client might lose its power rapidly if it waits for its transactions results for a long time. The replication technique should be able to replicate data items in appropriate servers in such a way that client power consumption is reduced [8].

• *Real-time applications*: MANET applications like rescue and military operations are time-critical and may contain both firm and soft real-time transactions. Therefore, the replication technique should be able to deliver correct information before the expiry of transaction deadlines, taking into consideration both real-time firm and soft transaction types in order to reduce the number of transactions missing their deadlines.

• *Frequent disconnection of mobile hosts*: Mobile hosts often get disconnected from the network due to various factors like power failure or their mobility. In addition, some mobile users switch their units on and off regularly to save power, causing more network disconnections. Servers which hold the data cannot provide services if they are disconnected from other mobile hosts. Thus, ideally, the replication algorithm should be able to determine when a particular mobile host would be disconnected and, accordingly, replicate its data items in a different server to improve data accessibility [9].

• *Network partitioning*: Due to frequent disconnection of mobile hosts, network partitioning occurs more often in MANET databases than in traditional databases. Network partitioning is a severe problem in MANET when the server that contains the required data is isolated in a separate partition, thus reducing data accessibility to a large extent. Therefore, the replication technique should be able to determine the time at which network partitioning might occur and replicate data items beforehand [10].

2. IMPLEMENTATION OF EFFICIENT ENERGY ANDNODE MOBILITY BASED DATA REPLICATION ALGORITM (EENMDRA)

In proposed Efficient Energy and Node Mobility based Data Replication Algorithm (EENMDRA), the data sharing is affected by four issues like determination of node mobility, determination of data access, Energy consumption prediction, and design of data replication. Our proposed algorithm consists of following issues. Before entering in to issues, we have made following assumptions.

• *Primary Assistants (P)*

These primary assistants are the original owners of data or a file. It decides with when and where to create replica including number of replicas is to be created.

• *Secondary Assistants (S)*

These are the mobile nodes that contain replicas and also maintain data availability. It serves the customer. It can also act as a primary assistant if it is disconnected from the network.

• *Customers (C)*

These are the mobile nodes that request or access the data. It acts as a forwarder or router when communication happens between the two assistants.

A .Determination of Node mobility

Mobility prediction may positively affect the service oriented aspects (network level) of ad hoc networking as well as the application-oriented aspects (application level). At the network level, accurate mobility prediction may be critical to tasks such as call admission control, congestion In this section, the basic system model is described. Then, we propose replica allocation methods for improving data accessibility in ad hoc networks. Control, reservation of network resources, pre configuration of services and QoS provisioning. At the application level, user mobility prediction in combination with user's profile may provide the user with enhanced location-based wireless services, such as route guidance, local traffic information, tourism services, on-line advertising, etc.
Node mobility partitions the network. If a mobile node moves out of range, it cannot able to provide services thereafter. If the node mobility is calculated in advance, its data can be replicated in an appropriate node to improve data availability. Before entering in to determination of node mobility some assumptions have been made in the network. Here the nodes are connected symmetrically. Thus the network is not partitioned. So the each node can measure its received signal strength. Each mobile node frequently sends some hello messages from the neighbour and also the distance is estimated. If a node is a primary assistant of a data, it collects and records the node movement of secondary assistants where secondary assistants need not be the neighbor nodes of a primary assistant.

3. PERFORMANCE ANALYSIS

We use NS2 to simulate our proposed algorithm. In our imulation, 100 mobile nodes move in a 1100 meter x 1100 meter square region for 60 seconds simulation time. All nodes have the same transmission range of 250 meters. The simulated traffic is Constant Bit Rate (CBR). Our simulation settings and parameters are summarized in table 1.
We evaluate mainly the performance according to the following metrics.

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Control overhead: The control overhead is defined as the total number of routing control packets normalized by the total number of received data packets.

End-to-end delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Simulation area	1500 X50 m
No. of nodes	100
Communication Traffic	CBR
Simulation duration	200 Seconds
Max. no. of connections	100
Max. Speed of a node	20 m/s
Packet rate	4 pkts/sec

Table 1: Simulation Parameters

Data Availability Ratio: It is defined as the making the copies of data items which shared by several users in a particular point of time. The simulation results are presented in the next part. We compare our proposed algorithm with Greedy Data Replication Algorithm (GDRA) in presence of node mobility and energy consumption environment.
Figure 1 shows the results of average end-to-end delay for varying the nodes from 20 to 100. From the results, we can see that EENMDRA scheme has slightly lower delay than the GREEDY DRA.

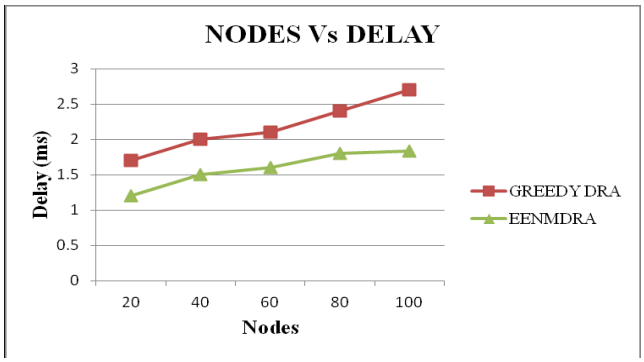

Figure 1: Nodes Vs End to end Delay

Fig.2 represents the comparison of overhead. It is clearly shown that the overhead of EENMDRA has low overhead than the GREEDY DRA.

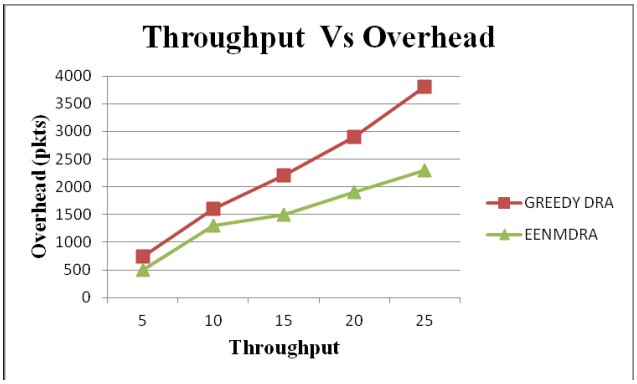

Figure 2: Throughput Vs Overhead

Figure 3 shows the results of Mobility Vs Delay. From the results, we can see that EENMDRA scheme has slightly lower delay than the GREEDY DRA.

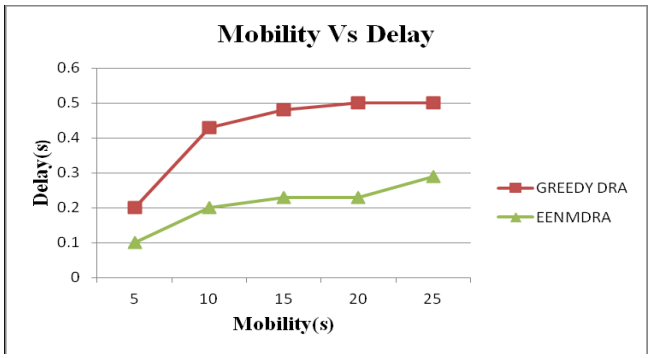

Figure 3: Mobility Vs Delay

Fig. 4 presents the comparison of total energy consumption while varying the mobility from 10 to 50. It is clearly shown that the energy consumption of EENMDRA has low overhead than the GREEDY DRA.

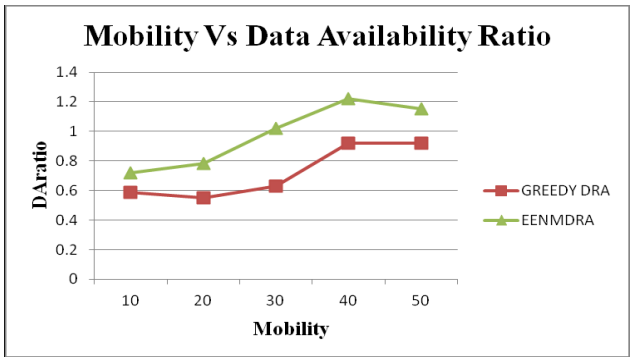

Figure 4: Mobility Vs Energy consumption

4. CONCLUSION

In MANETs, due to link failure, network partitions are common. As a result, data saved at other nodes may not be accessible. One way to improve data availability is through data replication. In this paper, we proposed several data replication schemes to improve the data availability and

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reduce the query delay. The basic idea is to replicate the most frequently accessed data locally and only rely on neighbor's memory when the communication link to them is reliable. Extensive performance evaluations demonstrate that the proposed schemes outperform the existing solutions in terms of data availability and query delay. Results also show that there is a fundamental trade-off between data availability and query delay. Higher degree of cooperation improves the data availability, but it also increases the query delay because more data need to be retrieved from neighboring nodes. By simulation results we have shown that the EENMDRA achieves data availability ratio while attaining low delay, overhead, minimum energy consumption than the existing schemes GREEDY DRA varying the number of nodes, node mobility.

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