A Co-Operative Cluster Based Data Replication Technique for Improving Data Accessibility and Reducing Query Delay in MANET's

Ashokkumar.R*, Baskaran P**

*Assistant Professor, SNS College of Engineering, Coimbatore, TamilNadu, India,
**Assistant Professor, SNS College of Engineering, Coimbatore, TamilNadu, India

Abstract- MANETs are very popular because of its infrastructure less network. These mobile nodes serve as both hosts and routers so they can forward packets on behalf of each other. It has restricted computing resources and due to mobility of node there is much change in network topology. These restrictions raise several new challenges for data access applications with the respects of data availability and access delay. This result in lower data availability in mobile ad-hoc networks than in wired networks. One probable solution to avoid this problem is to take up replication techniques which increases data availability and decrease query response delay. The replication process duplicates and preserves the consistency of multiple copies of objects in different sites so that each client node can visit a local copy of an object instead of remote ones. In this way replication can considerably enhances a distributed system's availability, reliability and scalability. It replicates the recurrently used data that rely on neighbour's memory when the connection among them is secure. The experimental result depicts that higher degree of data accessibility enhances the query delay also. So the proposed work is to enhance the data availability and decrease the query delay in the MANET. The proposed system deals with a better replication management technique for MANETs known as cluster related data replication technique to make available the needed data items from the neighbours node and able to choose which data items can be replicated at a node. After that there should be an effective replica restore algorithm to change the old copy of data items when change is required in the original copy of the data item. The results proved that proposed approach is much more efficient than the existing techniques.

Index Terms- Mobile Ad-Hoc networks, data replication, cooperative, query delay, data availability, clusters.

I. INTRODUCTION

In mobile ad hoc networks (MANETs), mobile nodes are in motion freely, network split-up may occur, where nodes in one partition cannot access data held by nodes in other partitions. Mobile adhoc networks considerably decrease the performance of data access. To solve this problem here data replication techniques will be used .Data replication can decrease the query delay due to the mobile nodes can get the data from some nearby replicas.

Data replication solutions in both wired and wireless networks aim at either reducing the query delay or improving the data availability. But the both metrics are important to the mobile nodes. In a MANET mobile nodes collaboratively share data. Multiple nodes exist in the networks and they send query requests to other nodes for some particular data items. Each node makes replicas of the data items and maintains the replicas in its memory (or disk) space.

During data replication, there is no central server that determines the distribution of replicas, and mobile nodes determine the data allocation in a distributed manner. Replicating most data locally can reduce the query delay, but it reduces the data availability due to many nodes may end up replicating the same data locally while other data items are not replicated by anyone.

To increase the data accessibility, nodes should not replicate the data that neighbouring nodes already have it on its memory. Though, several mobile nodes only have restricted memory space, bandwidth, and power, and hence it is impracticable for one node to bring together and maintaining all the data considering these facts. Queries generated during network partition may fail because the requested data items are not available in the partition to which the client belongs. Each node preserves a few quantities of data locally and the node is called the original owner of the data. To improve the data accessibility, these data items may be replicated to other nodes. The new data replication techniques are used to trade off between the query delay and data availability in MANET.

This improves the data availability in the MANET using data replication. Data replication is the process of cooperating information between the mobile nodes and ensures the consistency between the resources.

In MANET sharing information is not easy task because all the nodes the data saved at other nodes may not be accessible. The new data replication technique increases the performance level and address the query delay problem.

II. COOPERATIVE DATA REPLICATION

In cooperative data replication, a node cooperates with each other and shares their memory space for replicating data for neighboring nodes. Among several nodes from a network one may send requests to other nodes for some specific data items. Here every node creates and maintains replica's in its memory.

In cooperative data replication one node my allocate memory space for replicating data of their neighboring nodes data. So this way the degree of cooperation among mobile nodes will be maintained. Here each of the following approaches deals with increasing data access probability.

3.1 One to One Data Replication

In this approach each mobile node will cooperates at most one neighbor to decide data for replication. Among multiple available neighboring nodes it selects one node based on priority value for data replication.

Consider node N_1 and N_2 are neighboring nodes. a_{1d} and a_{2d} be the access frequency for data d from node N_1 and N2 respectively. Here each node computes cumulative access frequency to the data item d.

For N_1 to d $CAF_{12}^{d} = (a_{1d}+a_{2d} \times (1- f_{12}) / s)$ --(1)

For N_2 to d $CAF_{21}^{d} = (a_{2d}+a_{1d} \times (1- f_{12}) / s)$ –(2)

So the priority value for node as follows

$P_{12}^{d} = CAF_{12}^{d} \times f_{12}$ ……if replication is done at N_1

$P_{12}^{d} = CAF_{12}^{d}$ ……if replication is not done at N_1

Therefore here every node considers high priority value data for making replication process.

3.2 Reliable Neighbor Data Replication

In OTOO scheme, choice of choosing neighboring node is based access frequency while making replication. So it may reduce the degree of cooperation as such minimal. To increase the cooperation level, in reliable neighbor scheme node allocates more memory for replicating data for neighbors.

For the node N_1, N_2 to be a reliable neighbor

If $1 - f_{12} > \tilde{\imath}$ (threshold) ---- (3)

For a each node the allocated memory for replicating neighboring nodes data

$$C_{allocate} = C \times \min (1, \text{for all reliable neighbors } (1-f) / \alpha) \quad \text{------(4)}$$

In this scheme, the node makes replication of its available data up to the $C - C_{allocate}$. Then priority value is calculated for the node to the data item. Here the allocated memory is reserved for the data item with high priority value.

3.3 Reliable Grouping Replication

Here the OTOO considers only one neighbor and reliable neighbor chooses all one hop neighbors. But here to add more cooperation in RG scheme, the replicas of data will be shared among large reliable groups. So we can preserve a perfect cooperation between nodes. Initially all nodes transmits their ids and access frequency to all data items.

Here set of bi-connected nodes considered to be linked if and only they have a consistent link i.e.

$$1 - f_{12} > \tilde{\imath} \text{ (threshold)}$$

Then each set will be put into a group to form a reliable group. The average access probability of all data item is calculated using the following

$$P_d = \frac{\sum aik}{\text{no.of nodes} \times Sk} \quad \text{-----(5)}$$

The demand weighted access delay if replica of data d will be maintained at N_2,

$$T_{2d} = \sum a_i \times t_{12} \times s_d \quad \text{-------(6)}$$

Select the node with high P_d to replicate the data in which node selection minimizes the delay access in the group.

i.e., T_{1d} = min $\{T_{nd}\}$ for all node N_n € group. So here the allocation process is repeated until the entire data item is replicated.

3.4 Replica Management Using Clusters

With all the nodes having the reliable links cluster is formed by using the LCC algorithm. When a node requires some data item it sends request to cluster head. When a node receives a data item it replicate the data item locally for future use.

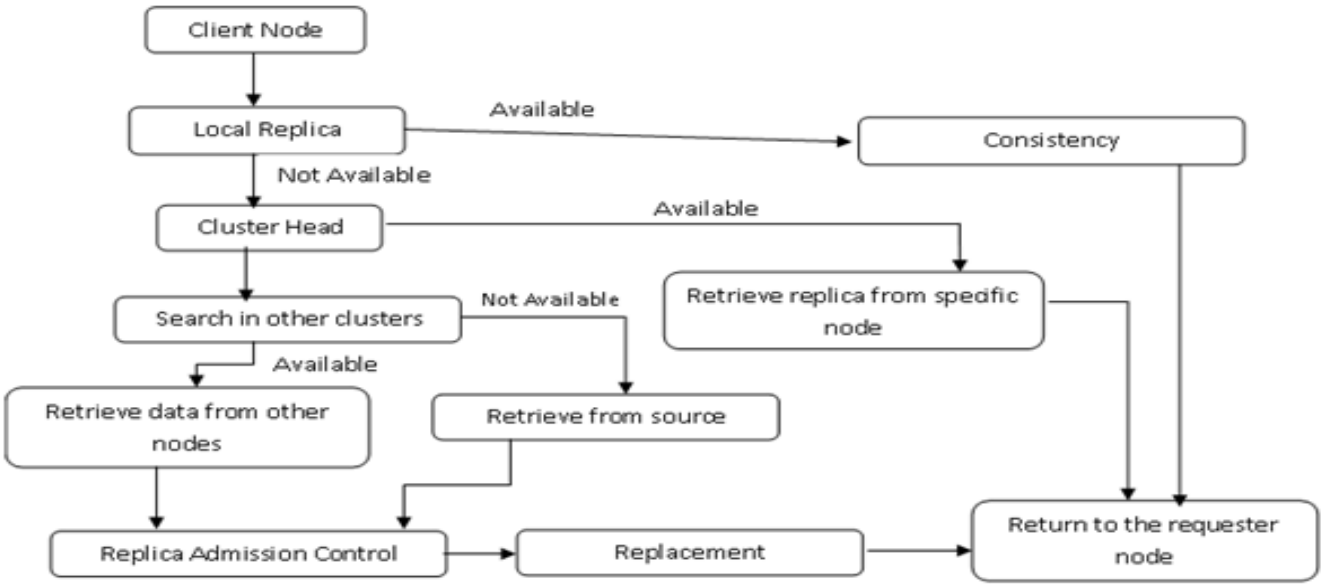

Fig.1 Replica Management Using Clustered Approach

Each mobile node is associated with a cluster and refers to the set of nodes that can be reached by the node within the given number of hops. Every cluster has its cluster head (CH). Each cluster head will maintain a table Replica Table (RT) and replica index (RI). This RT will contain the information about the replicas that are available with different node in that cluster. There will be 3 entries related to each node: node-id, item-id, space-available. The RI contains node id, data size and TTL value.

When a mobile node needs a new data item then first it will check whether the data item is locally available or not. If yes then data item is get back to the requester and if not the request forwarded to the CH. Now CH will check the item-id in RT to see whether the data item is available in the cluster. If any matched entry is found the request is redirected to that node pertaining to that item-id.

Otherwise CH will request that data item to other CHs if data is found then request forwarding is stopped and data is returned to the requester. When a node receives a data item then, it will make a replica of it for upcoming use. And an update message is send to its CH. In the process of returning the data item to the client node, a node in underlying path, if it is a CH, then it start replication process (RP).

In RP, initially cluster head will get the size of the data item whose replica needs to be created in that cluster. Now cluster head will check its RT and check for a node with free space available greater than the size of data item di. Now if CH gets a node with space-available greater than or equals to the size data item, then CH replicate the data item on that node.

After replicating data item on that node, node will send a message to the CH so that CH will update its entries related to that node in RT. Now if CH fails to get a node with space-available greater than or equals to the size data item, then CH will choose a node with maximum free space available. After selecting node CH redirect that node to call a procedure (MCR (NK, S)) to create enough space to replicate that data item on that node.

In this process the node will remove some data items. Decision of removing the data items at a node will be based upon the Replacement Policy. After successful creation of free space at that node, CH will replicating that data item on that node, node will send a message to the CH so that CH will update its entries related to that node in RT. After updating its RT, the CH will send this update that item is found then this update is discard otherwise CH will choose a mobile node where the replica of that item can be made. The node with maximum available free space will be selected.

IV.SIMULATION RESULTS

Here NS2 is used to stimulate the replica allocation and maintenance using clusters. The mobile adhoc network considered as an undirected graph G (V, E) in which it contains 30 mobile nodes for simulation using a random waypoint model. It contains n data items which are disseminated in the network. For simplicity all data items are in unit size. Here each mobile node can only replicate (C < number of nodes). Here the following figures represent data availability and query delay

simulation results as a graph. The reliable link is fully resided on link failure probability. Finding link failure probability is quite difficult and for simplicity we assume that it is based on signal strength.

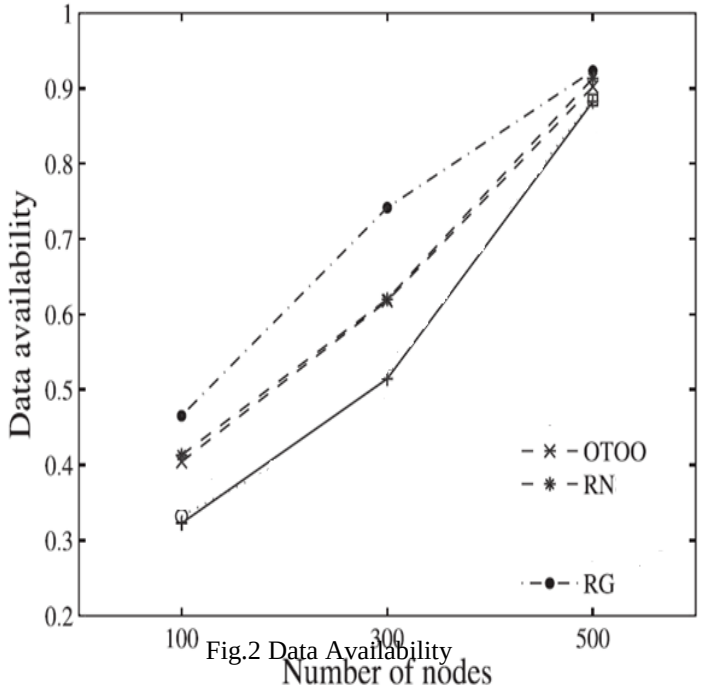

Fig.2 Data Availability

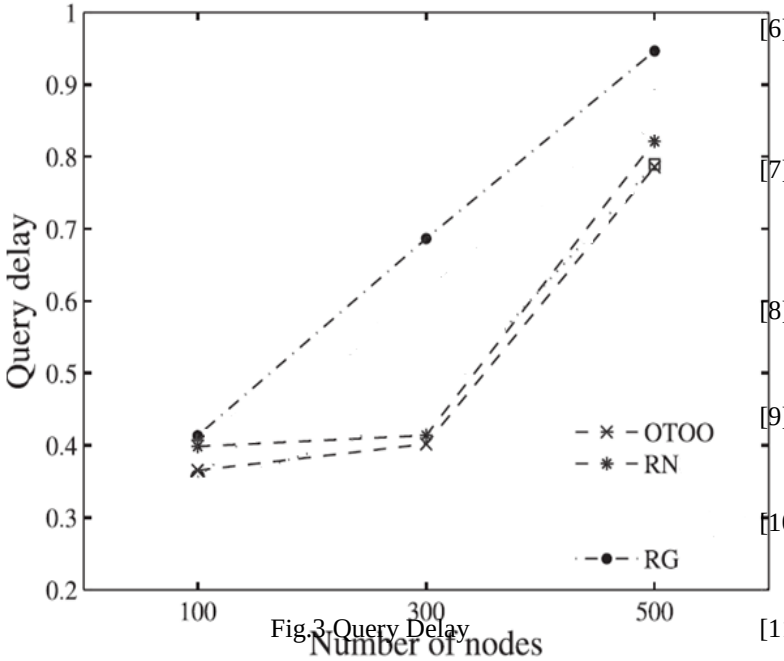

Fig.3 Query Delay

V. CONCLUSION

Network partitions are common due to link failure in MANETs. As a result data saved at other nodes may not be available. One way to improve data availability is through data replication. The proposed several data replication schemes improve the data availability and reduce the query delay. The perfect idea is to replicate the most frequently accessed data locally and only rely on neighbour's memory when the communication link to them is reliable. The proposed replication management technique for MANETs proved efficient to deliver requested data items from the neighbours node and capable to decide which data items can be replicated at a node. Also using cluster based replica allocation of data will make an effective trade-off between query delay and data availability in MANET's.

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AUTHORS PROFILE

R.Ashokkumar received the Bachelor Degree in Computer science and engineering from Kumaraguru College of technology, Affiliated to Anna University Chennai, India in 2007, Master of Science degree in information systems from Monash University, Australia in 2010. Currently he is working as an assistant professor in Computer Science and Engineering department, SNS College of Engineering, Coimbatore, TamilNadu, India. His area of interest includes network security, wireless sensor networks and distributed database.

Baskaran.P received the Bachelor Degree in Computer science and Engineering from Selvam College of Technology, affiliated to Anna University Chennai, India in 2010,

Masters degree in Software Engineering at the Anna University, Coimbatore in 2013. Currently he is working as an assistant professor in Computer Science and Engineering department, SNS College of Engineering, Coimbatore, TamilNadu, India. His area of interest includes network security, software engineering and mobile adhoc networks.