Volume 2, Issue 8, August 2012 ISSN: 2277 128X
International Journal of Advanced Research in
Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Reputation-Based Storage Space Allocation for Balancing the Tradeoffs between Data Availability and Query Delay in MANET

Mr.A.Christopher paul[1]
Assistant Professor,
Dept of CSE,
SNS College of Technology,
Anna University,
India

Mr.C.Chandru Vignesh[2]
Assistant Professor,
Dept of CSE,
SNS College of Technology,
Anna University,
India

Dr.S.Karthik[3]
Professor & Dean,
Dept of CSE,
SNS College of Technology,
Anna University,
India

ABSTRACT— Network partition in mobile adhoc networks (MANET's) is basic behaviour happens due to node's mobility and node/link failures. Due to that the data accessibility process in network was found data unavailability. Normally node wants to access data from another node it needs query transmission process, the partition of networks will make delay in providing such requested data. The basic 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. In this approach, the selfish caching issue in MANET is formulated as a non-cooperative problem. For solving this problem, we propose an efficient storage space allocation approach for data replication problem while nodes are in selfish behaviours. In this approach each node independently decides how to allocate its available storage space. It is based on which each node determines the quality of service that the device will offer to each one of their requesters according to their reputations and demands. It dynamically adapts the capacity that they dedicate for uploading and downloading in order to improve their utility.

Keywords— Data Availability, Data replication, Mobile Ad ho Network (MANET), non-cooperative problem.

I. INTRODUCTION

In mobile ad hoc networks (MANETs), due to mobility of nodes the network partition may occur, where nodes in one partition cannot access data held by nodes in other partitions. Data replication is the better solution to improve data availability in distributed systems. By replicating data at mobile nodes which are not the owners of the original data, data availability can be improved because there are multiple replicas in the network and the probability of finding one copy of the data is higher. Also, data replication can reduce the query delay since mobile nodes can obtain the data from some nearby replicas. But the most mobile nodes only have limited storage space, range, and power, and hence it is impossible for one node to collect and hold all the data considering these constraints and non-cooperative nodes in MANETs cause data unavailability for the requesters because of selfish behavior. When a node only replicates part of the data, there will be a trade-off between query delay and data availability. The solution is to replicate the most frequently accessed data locally and only rely on neighbor's memory when the communication link to them was reliable, proposed by Yang Zhang [1]. In that they consider the query delay and balancing tradeoffs between nodes but not consider the non-cooperative nodes (selfish behavior) avoids the data replication for conserve their resources, but it access data from others. By taking these issues into consideration, we expect all mobile nodes should cooperate to replicate their data items in the network and provides high data availability with low query delay. This will improve the data access performance within resource constraints of mobile nodes. The contribute part of their storage space to hold data of other mobile nodes in [1], [2]. Many methods have been used in the literature to motivate users to cooperate by trust- and reputation-based methods [4].

In this paper, the main objective of our research is to investigate self caching problem and provide solutions for that problems in data replication schemes in MANET while balancing the Tradeoffs between Data Availability and Query Delay. We propose a distributed reputation-based system according to which node earn reputation analogous to their contributions. In this way, each node has to trade off the capacity they will dedicate for uploading in order to increase their reputation and therefore their revenue and the capacity they will dedicate for downloads. All nodes act rationally, trying to maximize their utility. Simulation results show that the proposed schemes can reduce selfish caching problem and provide satisfying system performance.

The rest of the paper is organized as follows: The next section presents some related work. In Section 3, we describe the proposed schemes in detail model description. Section 4 we explained the Capacity Allocation Strategies and Section 5 reviews the performance of our approach finally section 6 and 7 performance evaluation and concludes our approach.

© 2012, IJARCSSE All Rights Reserved

II. RELATED WORK

Dynamic Access Frequency and Neighborhood (DAFN) scheme proposed by Hara [10], neighboring nodes should try to remove duplicated data items to save storage space and increase data availability. Heuristics base approach: For a mobile node, if its communication links to other nodes are stable, more cooperation with these nodes can improve the data availability; if the links to other nodes are not very stable, it is better for the node to host most of the interested data locally. For query delay, it is better to allocate data near the interested nodes one naive greedy data replication scheme is to allocate the most frequently accessed data items until the memory is full. In One-To-One Optimization (OTOO) Scheme, each mobile node only cooperates with at most one neighbor to decide which data to replicate. Reliable Neighbor scheme which contributes more memory to replicate data for neighboring nodes. In this scheme, part of the node's memory is used to hold data for its Reliable Neighbors Reliable grouping scheme which shares replicas in large and reliable groups of nodes, whereas OTOO and RN only share replicas among neighboring nodes. Drawbacks of such system were DAFN does not consider two important factors: the link stability between mobile nodes and the query delay. In heuristic approaches the degree of cooperation affects both the data availability and the query delay. Greedy, does not consider the data size difference between different data items. The data size should be considered because smaller data require less memory space, and hence replicating them can save some memory space for other data items. However, the cooperation in both OTOO and RN are not fully exploited. None of the methods in existing system talks about nodes malicious or selfish behavior and non cooperation. We overcome those drawbacks by consider that our system progresses in periods of a fixed number of time units. Each nodes decides about the storage space that the node will dedicate in a given period for uploading to others (we will refer to it as upload storage space), and the storage space that they will use for their own needs. We model rational nodes who aim at maximizing their utility (the amount of resources that they receive) by strategically adjusting their capacities. In the proposed system the node who gives more storage space for others it will get more reputation points .If the node give less storage space for others will get low reputation scores. In a replication system, highly reputed nodes are better off by trading with other highly reputed nodes, while low reputed nodes can be satisfied when trading either with other low reputed nodes. If nodes want more replication of its data to another node it will give space for other nodes, then only it can get more spaces. Advantages of our approach are reputation metric and update mechanism gradually exposes the cooperation level of each node in terms of the quality of service it provides and dynamically adapts to possible nodes behavior variations. The reputation based mechanism improves the performance of MANET while balancing trade off s between Data Availability and Query Delay in MANET.

III. MODEL DESCRIPTION

We consider that the access technology does not provide strict separation between upstream and downstream flows; therefore, nodes have to share their link capacity between their upload and download connections. There are implementation tools [5] which can be used to appropriately adjust the upload and download range for each connected user without modifications in the access protocol, but these issues are out of the scope of this paper. We consider that each node i is connected to the Cooperative Network through an access link with capacity Ci (measured in b/s), reflecting his available range for uploading and downloading content. The capacity of the cooperative network is regarded sufficient to accommodate all the traffic between the nodes. This assumption is quite realistic as previous studies have shown that the access links are most likely to be the bottleneck and not the cooperative [6].

Notation	Definition
N	Number of nodes in the network
Ci	Overall capacity of node i
dCpi	Download capacity of node i during period p
uCpi	Upload capacity of node i during period p
gi	Number of requests per period of node i
bi	Capacity step of node i
Rpij	Reputation of node j in eyes of node i
Reqpij	Total number of requests from node I to node j till period p

Our focus in this paper is how to dynamically allocate in a distributed way the resources of the MANET community among their members in a way to provide fairness and efficiency in the system by guaranteeing that nodes will be able to receive resources in proportion to their contributions, and that all available resources will be fully exploited. These issues are more meaningful in heavy loaded networks, where nodes fight for resources. In light loaded networks, where the available resources exceed the needs of the nodes, there is no obvious necessity for incentive mechanisms to force nodes to contribute their resources; although, in some cases nodes may wish to free ride for other reasons. In the latter cases, our policies can be applied to ensure that nodes will only be able to receive resources in proportion to their contributions, motivating them to cooperate at least as much as it is needed to satisfy their own needs. However, in this paper, we model an overloaded network as in [7], where there are always requests for downloading and content to be downloaded, i.e., a node community where an infinite number of chunks of the same data are shared, where we can investigate the efficiency of our proposed policies in the worst possible conditions (overloaded networks). Content segmentation into chunks or content discovery issues are out of our scope, but we rather consider that chunks can be found by any other than the requester node in the system. We consider that our system progresses in periods of a fixed number of time units. Each node decides about the capacity that he will dedicate in a given period p for uploading to others (we will refer to it as upload capacity in the rest of the paper), uCpi, and the capacity that he will use for his own needs (we will refer to it as download capacity in the rest of the paper), uCpi. It is obvious that uCpi + dCpi = Ci for any p and i. We model rational nodes who aim at maximizing their utility (the amount of resources that they receive) by strategically adjusting their capacities. In the beginning of each period, each node i connect to gi different nodes simultaneously in order to receive chunks of the data. Variable gi represents the request generation prodata of each node i; nodes with higher g try to receive more resources than other nodes, during a period p. In each one of his connections, node i reports his demands (in terms of range) for the given request. The nodes acting as nodes will allocate their resources among competing nodes according to their reputations and demands, following one of our allocation policies. The service is not granted for more than a period, in order to give the chance for other nodes to access the link. Every new period, nodes redirect their requests to the same or possibly other nodes aiming at improving their received quality of service. The framework of the protocol can be briefly described in the following steps for a random period p, while the individual proposed strategies, reputation metric, allocation, and node selection policies are described in detail in the following sections:

Step 1: At the beginning of a period p, each node decides where to send his gi requests (randomly or according to our reputation-based node selection policy) and the amount of range he will request from each one of his nodes under Basic, Greedy, or Adaptive strategy described in the following section. During his first download period in the system, a node sets dCpi = Ci and uCpi = 0. This corresponds to either newcomers, i.e., nodes that joined the system for the first time in order to download something or old nodes who were idle for some time (not downloading) and decided to begin downloading again. We will refer to both newcomers and such old nodes as beginners.

Step 2: Each node allocates his current upload capacity uCpi over the nodes' requests that were directed to him. If the node is a beginner, he does not serve any request (uCpi = 0). Allocation is performed through our proposed reputation-based allocation policies.

Step 3: At the end of the period p, each node calculates the reputation of his nodes based on the service he received from them during this period and he adjusts the capacities uCp+1i and dCp+1i for the next period p+1, based on the capacity allocation strategy described in Algorithm 1.

IV. CAPACITY ALLOCATION STRATEGIES

We consider that each node in the network seeks to maximize his utility, i.e., the amount of resources he receives from the network. Therefore, each beginner will

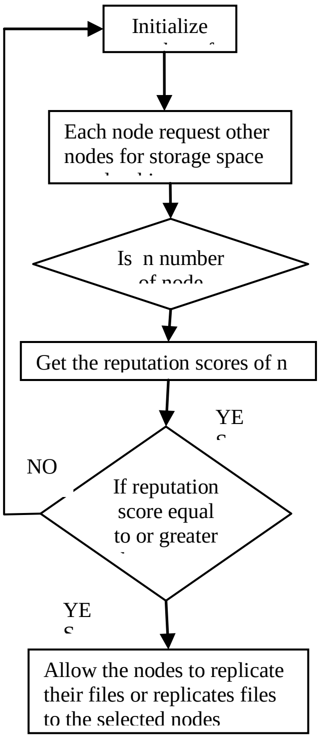

Fig.4.1. Flow Diagram

Initially dedicate his whole capacity only for his own needs (downloads). Under the presence of the proposed reputation system in the network, though, the reputation of this node will significantly fall, since he does not contribute any resources to the network, and this will affect his performance. The existence of the reputation system forces each node to trade off his capacity among his upload streams, in order to increase his reputation and thus his revenue, and his download streams. We model rational nodes who try to maximize their utility with the least possible contributions, by progressively increasing their upload capacity till they obtain the quality of service they desire. Therefore, if the range a given node i receives during a period p (Bpi) is smaller than the capacity that he dedicates for downloading in the given period, it means that he needs to increase his cooperation level in order to improve his reputation and be able to receive more resources from the network. So, in this case, node i will increase his upload capacity by a constant bi as soon as it does not exceed his total capacity and decrease the download capacity by the same constant bi. On the other hand, if the node receives as much range as his download capacity can afford, he will try to maximize his utility by further increasing his download capacity by the constant bi for the next p + 1 period, in cost of decreasing his upload capacity by the same constant bi. From our simulations, we saw that a good trade-off between convergence rate and performance is succeeded in the system when each node i uses a bi in the order of Ci=10. Aforementioned algorithm is presented below.

Algorithm 1. Capacity Allocation Strategy for Node i

```
    if (Bpi < dCpi) AND (uCpi < Ci –bi) then
uCp+1i= uCpi + bi
    else if (Bpi== dCpi ) AND (uCpi>=bi) then
uCp+1i= uCpi - bi
end if
dCp+1i = Ci - uCp+1i
```

Someone could argue here that a node i may receive less range than his download capacity in a period p, not because he is not cooperative enough but because of the existence of misbehaving (non-cooperative) nodes in the system. Therefore, he should not further increase his cooperation level, i.e., his upload capacity. However, our reputation-based node selection policy refrains nodes from requesting service from misbehaving nodes. Moreover, the latter cannot take advantage of the increased cooperation level of high capacity nodes, because of their low reputation as we will see in the sequel. As soon as nodes decide about their download capacity for a given period p, they determine their demands from their nodes according to greedy strategy.

In the greedy strategy, each node i requests from each one of his nodes range equal to his total current download capacity. In this way, he increases the possibility of receiving more range from an available and capable node. If the upload capacity of a node i is not fully exploited (because the demands of the competing nodes are less than his available upload capacity), he uses the residual capacity for downloading. However, even then, the node's available capacity for downloading may not be high enough to accommodate incoming flows, e.g., when more than one node offers ranges equal to the requested one. We note here that as soon as nodes decide the portions of their upload capacity that they will give to each one of their requesters at a given period p, we consider that they reserve these portions for their requesters' needs for the specific period. If their requesters cannot absorb these resources, they remain unexploited. Simulation results have shown that although the average range received by each node is increased compared to the basic strategy, a lot of range which has been reserved for uploading is not utilized because it exceeds the download capacity of the requesters. If, however, nodes release the upload capacity committed for the certain needs of some requesters when the latter's download capacity cannot sustain it and use it for other requesters or their own needs, they will make better exploitation of their resources.

V. REPUTATION-BASED NODE SELECTION POLICY (NS)

In this section, we describe a reputation-based node selection policy in order to help nodes avoid requesting service from misbehaving (non-cooperative) ones. When nodes enter the system for the first time, they do not have information about the behaviors of the other nodes in the system. So, for a short period of time, which we call acquaintance duration, new nodes direct their requests to all nodes with equal probability (random selection policy), till they obtain an overview of the network. Similarly, preexisted nodes in the system will use the random selection policy among their old providers and new nodes in the system during time duration equal to the acquaintance duration in order to test the behavior of the newcomers. After this time duration, the probability with which a node i directs his request to a node j at a given period p, is directly proportional to j's local reputation to i, as

$$p_{ij}^{p} = R_{ij}^{p} \Big/ \sum_{s \in S_{i}^{p}} R_{is}^{p},$$

where Spi is the set of all node i's transacting nodes till period p. A similar policy is used in [8] and [9], where though corresponding probability is proportional to a global reputation and not a local one. As we already explained in a previous section, by using local reputations nodes tend to select the appropriate traders for them, according to their particular needs.

VI. PERFORMANCE EVALUATION

A. *Simulation Model*

In order to evaluate the performance of our system, we simulate a MANET network of 100 nodes. To bootstrap the system, all nodes start with an initial small reputation of 0.07. Reputation threshold, below which a node does not receive service, even when he is the only one competing for resources, is 0.01. Acquaintance duration under which new nodes send their requests with equal probability to all others, in order to have a global picture of the network is set to 50 periods. Simulation time was set to 1,000 periods. We consider that each node i uses a constant bi equal to 0.5 Mb/s, when performing the strategy of Algorithm 1. We run the system for different random initial reputation metrics for all nodes and our simulation results have shown that reputations quickly converge to the same steady state, as with any initial reputation conditions and depend solely on the contributions of the nodes. Similarly, we investigated the system for different initial conditions for the upload download capacities of all nodes and saw that each node's performance always reaches the same steady state which depends on the capacities of all nodes in the system. The performance of the system scales even to larger overlay networks; however, in larger networks the convergence time of the reputations and performance metrics increases.

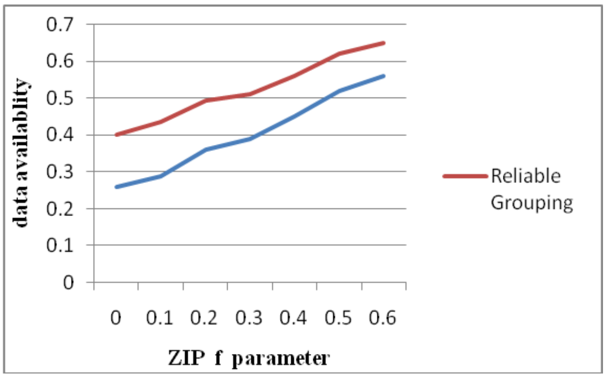

Fig.6.1.1 Data Availability

Fig 6.1.1 shows that when nodes have different access patterns, the proposed schemes increase the data availability while providing lower zipf and query traffic compared to the DAFN scheme. The difference of data availability for OTOO, Greedy and DAFN is not very large because when nodes have different access pattern, they can simply replicate their interested data locally to achieve a high data availability. Thus, the room for improvement is small. RG, however, organizes data replications within each reliable group. It can provide more different data items in each group. Thus, its data availability is much higher than other schemes.

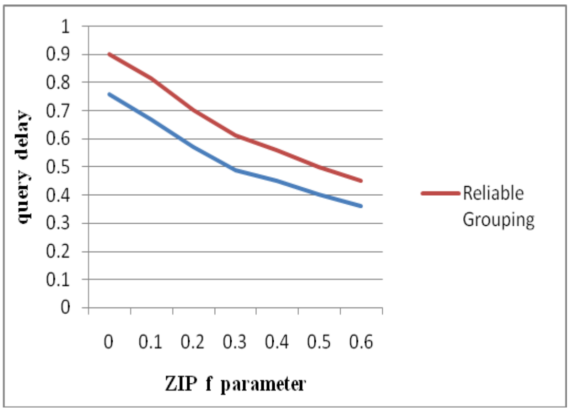

Fig.6.1.2 Query Delay

VII. CONCLUSIONS

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 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.

In this paper, we presented a complete methodology for motivating nodes to contribute their resources in a loaded network where the capacity-limited access link of each node is shared among his download and upload streams. Our proposed allocation scheme is implemented in a distributed manner at each node, without the necessity of any global information. We considered rational nodes who seek to maximize their utility with the least possible contributions and showed that under the presence of our proposed reputation system they are inclined to cooperation. In the homogeneous scenario where all nodes have the same capacity and request generation rate, rational nodes fast reach a cooperative operating point under which they offer half of their capacity for their download and half for their upload streams. In heterogeneous systems, utilization of all resources is not always possible since some of the higher capacity (powerful) nodes' resources may not be exploited because of the inability of other nodes to offer and receive resources at the rate that powerful nodes can accept and provide, respectively. However, fairness is still guaranteed as nodes receive resources in proportion to their contributions.

REFERENCES

[1] Yang Zhang, Liangzhong, Yin, Jing Zhao, and Guohong Cao *"Balancing the Trade-Offs between Query Delay and Data Availability in MANETs" ,* IEEE Trans, parallel and distributed systems, VOL. 23, no. 4, APRIL 2012

[2] T. Hara and S.K. Madria, *"Data Replication for Improving Data Accessibility in Ad Hoc Networks,"* IEEE Trans. Mobile Computing,vol. 5, no. 11, pp. 1515-1532, Nov. 2006.

[3] L. Yin and G. Cao, *"Supporting Cooperative Caching in Ad Hoc Networks,"* IEEE Trans. Mobile Computing, vol. 5, no. 1, pp. 77-89, Jan. 2006.

[4] T.G. Papaioannou and G.D. Stamoulis, *"Reputation-based Policies that Provide the Right Incentives in Node-to-Node Environments,"* Computer Networks, special issue on management in node-to-node systems: trust, reputation, and security, vol. 50, no. 4, pp. 563-578,2006.

[5] B. Hubert et al., *"Linux Advanced Routing and Traffic Control HOWTO,"* http://lartc.org/, 2009.

[6] A. Odlyzko, *"Data Networks are Lightly Utilized, and Will Stay that Way,"* Rev. of Network Economics, vol. 2, no. 3, pp. 210-237, Sept. 2003.

[7] M. Meo and F. Milan, "*A Rational Model for Service Rate Allocation in Node-to-Node Networks*," Proc. Eighth IEEE Global Internet Symp. (GI), Mar. 2005.

[8] T.G. Papaioannou and G.D. Stamoulis, "*Reputation-based Policies that Provide the Right Incentives in Node-to-Node Environments,"* Computer Networks, special issue on management in node-to-node systems: trust, reputation, and security, vol. 50, no. 4, pp. 563-578,2006.

[9] S. Marti and H. Garcia-Molina, *"Limited Reputation Sharing in p2p Systems,"* Proc. Fifth ACM Conf. Electronic Commerce, pp. 91-101, 2004.

[10] T. Hara, *"Effective Replica Allocation in Ad Hoc Networks for Improving Data Accessibility,"* Proc. IEEE INFOCOM, 2001.

.
CHRISTOPHER PAUL A is an Assistant Professor of Computer Science and Engineering at SNS College of Technology, Anna University. He received a B.E degree in Computer Science and Engineering from Anna University, India in 2008 and M.E degree in Computer Science and Engineering from Anna University of Technology, India in 2011.His research works including Mobile Networks, Distributed Computing and Software Architecture

CHANDRU VIGNESH C has completed his B.E Degree in Computer Science and Engineering from SNSCT, in Anna University, Chennai in year 2008.He obtained his Master's Degree in Software Engineering from SREC in Anna University, Coimbatore in year 2011. His research interest focuses on Wireless Communication, Mobile Computing and Computer Networks. He has presented one paper in National conferences and two papers in International Conferences. At Present, he is an Assistant Professor of Computer Science and Engineering at SNS College of Technology, Anna University, India.

Dr.S.KARTHIK is presently Professor & Dean, Department of Computer Science & Engineering, SNS College of Technology, affiliated to Anna University, Tamilnadu, India. He has received his Master Degree in Engineering from Anna University Chennai and Ph.D degree from Anna University Chennai in the area of information and Communication Engineering. His research interests include network security, web services and wireless systems. In particular, he is currently working in a research group developing new Internet security architectures and active defense systems against DDoS attacks. Dr.S.Karthik published papers in international journal and conference papers and has been involved many international conferences as Technical Chair and tutorial presenter. He is an active member of IEEE, ISTE and Indian Computer Society.