Balancing The Trade-Offs Between Query Delay And Data Availability In MANET's

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***Abstract*— In mobile ad hoc networks (MANETs), nodes move freely and link/node failures are common, which leads to frequent network partitions. Due to this network partition, mobile nodes in one partition are not able to access data hosted by nodes in other partitions, and hence significantly degrade the performance of data access. So to deal with this problem, we apply data replication techniques. Most of the mobiles have limited amount of storage and bandwidth. So it is impossible for them to hold all the data needed for replica. To overcome this problem we are implementing some of the following techniques: The One-To-One Optimization (OTOO) Scheme, the Reliable Neighbor (RN) Scheme and Reliable Grouping (RG) Scheme. In OTOO scheme each node will replicate the data of the most neighbor data item. In RN scheme each node will replicate the data item of one neighbor to other. In RG scheme node will replicate the data item in large group so that each and every node can use the shared data.**

Keywords- MANETs, data replication, data availability, query delay.

I. INTRODUCTION

RECENT advancements in wireless communication and the miniaturization of computers have led to a new concept called the mobile ad hoc network (MANET), where two or more mobile nodes can form a temporary network without need of any existing network infrastructure or centralized administration [1].

Mobile Ad hoc network:

Opposed to the infrastructure wireless networks where each user directly communicates with an access point or base station, a mobile ad hoc network, or MANET is a kind of wireless ad hoc network [2]. It is a self configuring network of mobile routers connected by wireless links with no access point. Every mobile device in a network is autonomous. The mobile devices are free to move haphazardly and organize themselves arbitrarily. In other words, ad hoc network do not rely on any fixed infrastructure (i.e. the mobile ad hoc network is infrastructure less wireless network). The Communication in MANET takes place by using multi-hop paths. Nodes in the MANET share the wireless medium and the topology of the network changes erratically and dynamically. In MANET, breaking of communication link is very frequent, as nodes are free to move to anywhere. The density of nodes and the number of nodes depends on the applications in which we are using MANET. Figure 1 gives the basic idea how number of nodes (i.e. mobiles or laptops etc.) are connected using Ad-hoc.

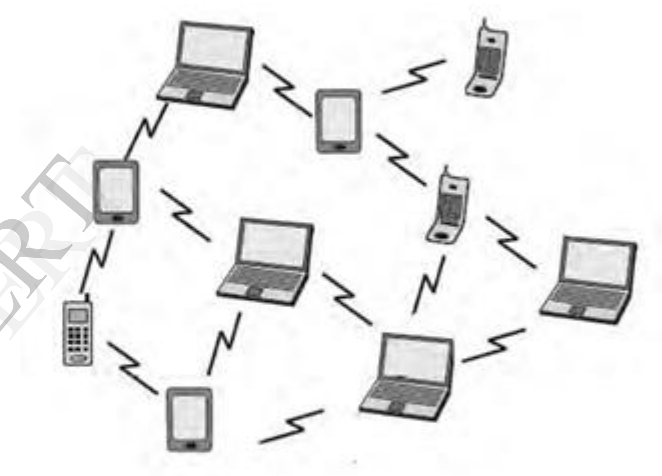

Fig. 1. Mobile Ad hoc network

Wireless system operates with the aid of a centralized supporting structure such as an access point. Access points assist the wireless users to keep connected with the wireless system, when they roam from one place to other. Wireless system allows the devices to communicate via radio channel to share resource and information. Due to presence of a fixed supporting structure, limits the adaptability wireless system is required easy and quick deployment of wireless network. Recent advancement of wireless technologies like Bluetooth, IEEE 802.11 introduced a new type of wireless system known as Mobile ad-hoc network (MANETs), which operate in the absence of central access point. It provides high mobility and device portability's that enable to node connect network and communicate to each other and also allows the devices to maintain connections to the network as well as easily adding and removing devices in the network.

User has great flexibility to design such a network at cheapest cost and minimum time. When a network partition occurs, mobile nodes in one partition are not able to access data hosted by nodes in other partitions, and hence significantly degrade the performance of data access.

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. MANETS can be used for facilitating the collection of sensor data for data mining for a variety of applications such as air pollution monitoring and different types of architectures can be used for such applications. However, in MANETs, there are also many applications in which mobile nodes share data and access data held by other mobile nodes. This kind of networks can be used in many applications like collaborative rescue operations at a disaster site, military operations, sensor networks, and exchange of word-of-mouth information in a shopping mall. For such applications, preventing the deterioration of data availability at the point of network partitioning is a very significant issue. More specifically, as mobile nodes move freely in MANETs, disconnections often occur, and this causes data in two separated networks to become inaccessible to each other.

To deal with this problem, we apply data replication techniques. Existing data replication solutions in either wired or wireless networks aim at either reducing the query delay or improving the data availability, but not both. As both metrics are important for mobile nodes, we propose schemes to balance the tradeoffs between data availability and query delay under different system settings and requirements.

The rest of paper is organized as follows: Section II gives an explanation on data availability or Replication in MANETs. Section III presents the problem definition. Section IV discusses the methodologies used in this paper. Our conclusion is based on data replication and problem defined in this paper in section V.

II. DATA AVAILABILITY (REPLICA):

Data availability or replica means sharing information so as to ensure consistency between redundant resources. Data replication has been widely used to improve data availability in distributed systems, and we will apply this technique to MANETs. 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. For data replication protocols, significant factors that affect the performance are how many data items can be replicated on connected mobile nodes and how often and how much the groups of connected mobile nodes change. However, most mobile nodes only have limited storage space, bandwidth, and power, and hence it is impossible for one node to collect and hold all the data considering these constraints. One solution to improve the data access performance considering the resource constraints of mobile nodes is to let them cooperate with each other; That is, contribute part of their storage space to hold data of others. When a node only replicates part of the data, there will be a trade-off between query delay and data availability. For example, replicating most data locally can reduce the query delay, but it reduces the data availability since many nodes may end up replicating the same data locally, while other data items are not replicated by anyone. To increase the data availability, nodes should not replicate the same data that neighboring nodes already have. However, this solution may increase the query delay since some nodes may not be able to replicate the most frequently accessed data, and have to access it from neighbors. Although the delay of accessing the data from neighbors is shorter than that from the data owner, it is much longer than accessing it locally. In this paper, we propose different data replication techniques to address query delay and data availability issues. As both metrics are important for mobile nodes, we propose techniques to balance the trade-offs between data availability and query delay under different system settings and requirements.

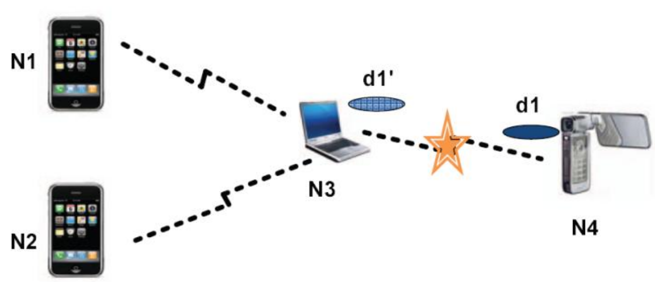

Fig. 3. Network partition due to link failure in a MANET

Figure 3 shows an example of how data replication can be used to improve the performance of data access when network partitions. There are four nodes in the network. *N*4 is a web camera which continuously records video clips (*d*1) of its surroundings. Two client's *N*1 and *N*2 periodically access these video clips by using *N*3 as relay. However, when a disconnection occurs between *N*3 and *N*4 due to a link failure, *d*1 becomes un-accessible to the other three nodes. To improve data availability, a copy of *d*1 can be replicated at *N*3 before the disconnection. Then both *N*1 and *N*2 can access *d*1 even if they are not able to connect with *N*4. Further, by replicating a copy of *d*1 at *N*3, *N*1 and *N*2 can access *d* within one hop, reducing the query delay.

III. PROBLEM DEFINITION

Data access performance:

Due to network partitions mobile nodes cannot move freely in other partitions and hence cannot access the shared data from another network partitions.

EXISTING SYSTEM:

Existing data replication solutions in either wired or wireless networks aim at either reducing the query delay or improving the data availability, but not both. Padmanabhan [6] *et al.* identified several research issues in data replication in MANET and attempted to classify existing data replication techniques. Hara [7], [3] proposed data replication schemes for ad hoc networks. These schemes are based on the intuition that replicating the same data near neighboring nodes should be avoided in order to improve data availability. However, this intuition may not be valid when the link failure probability is taken into consideration. Also, it only considers the availability, without considering the query delay. We will address these issues in this paper to provide better data replication. Some other researchers address data access issues in MANETs considering network partitions. Huang and Chen [10] addressed the problem of replica allocation in a MANET by exploring group mobility. Wang and Li [11] proposed schemes to deal with network partitions due to node movement by replicating services in the network. Their schemes can provide guaranteed service with minimum number of replicated services. Hara [1] proposed several metrics to evaluate the impact of mobility on data availability. Some of previous papers have discussed replica allocation in ad hoc networks to improve data accessibility. Firstly, they have proposed three replication methods in an environment where each data item is not updated. Then, they extended these three methods by considering a-periodic data updates since, in a real environment, updates do occur a-periodically. The simulation results showed that the three extended methods work well in an environment where each data item is randomly updated and mobile users behave based on their schedules. Due to this there is a trade-off relationship between the improvement of data accessibility and the reduction of traffic. The simulation results also showed that the three extended methods give poor performance when some data items have very low write frequencies and not high access frequencies. However, many mobile nodes only have limited storage space, bandwidth and power, and hence it is impossible for one node to collect and hold all the data considering these constraints.

Disadvantages:

One drawback of the greedy scheme is that it does not consider the cooperation between the neighboring nodes and hence its performance may be limited.

PROPOSED SYSTEM:

In this paper, we propose new data replication techniques to address query delay and data availability issues. As both metrics are important for mobile nodes, we propose techniques to balance the tradeoffs between data availability and query delay under different system settings and requirements. Here we solve the problem by replicating data items on mobile hosts. Data replication has been extensively studied in the web environment [13] and distributed database systems. However, most of them either do not consider the storage constraint or ignore the link failure issue. Before addressing these issues by proposing new data replication schemes, we first introduce our system model. In a MANET, mobile nodes collaboratively share data. Multiple nodes exist in the network and they send query requests to other nodes for some specified data items. Each node creates 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 allocation of replicas, and mobile nodes determine the data allocation in a distributed manner. Data replication is suitable to improve the response time, the global traffic, and the sharing of data since even in the case of disconnection of a server. The nodes can continue to have access to replicas of data. Most of the replication schemes have link failure issue. On an Ad hoc mobile network, the frequent partition of the network and the lack of fixed infrastructures complicate the data access and the sharing task.

IV. METHODOLOGIES

A. Data Replication:

Data replication has been extensively studied in the Web environment and distributed database systems. However, most of them either do not consider the storage constraint or ignore the link failure issue. Before addressing these issues by proposing new data replication schemes, we first introduce our system model. In a MANET, mobile nodes collaboratively share data. Multiple nodes exist in the network and they send query requests to other nodes for some specified data items. Each node creates 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 allocation of replicas, and mobile nodes determine the data allocation in a distributed manner.

Data replication has been extensively studied in the Web environment, where the goal is to place some replicas of the web servers among a number of possible locations so that the query delay is minimized. In the Web environment, links and nodes are stable. Thus, the performance is mainly measured by the query delay. Moreover, these schemes replicate at the whole database level; that is, the whole database is replicated as a unit to one or more locations. It is more complex when replication is done at the data item level, i.e., how to replicate data items to various nodes with limited memory space. Data replication has been studied in distributed database systems. In such systems, nodes that host the database are more reliable and less likely to fail/disconnect compared to those in MANETs. Therefore, a small number of replicas can be used to provide high availability. However, in MANETs, node/link failure occurs frequently, and data availability becomes an important issue.

B. The One-To-One Optimization (OTOO) Scheme:

It considers the access frequency from a neighboring node to improve data availability. It considers the data size. If other criteria are the same, the data item with smaller size is given higher priority for replicating because this can improve the performance while reducing memory space. It gives high priority to local data access, and hence the interested data should be replicated locally to improve data availability and reduce query delay. It considers the impact of data availability from the neighboring node and link quality. Thus, if the links between two neighboring nodes are stable, they can have more cooperation's in data replication.

C. The Reliable Neighbor (RN) Scheme:

OTOO considers neighboring nodes when making data replication choices. However, it still considers its own access frequency as the most important factor because the access frequency from a neighboring node is reduced by a factor of the link failure probability. To further increase the degree of cooperation, we propose the Reliable Neighbor (RN) 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*. If links are not stable, data on neighboring nodes have low availability and may incur high query delay. Thus, cooperation in this case cannot improve data availability and nodes should be more "selfish" in order to achieve better performance.

D. Reliable Grouping (RG) Scheme:

OTOO only considers one neighboring node when making data replication decisions. RN further considers all one-hop neighbors. However, the cooperation's in both OTOO and RN are not fully exploited. To further increase the degree of cooperation, we propose the reliable grouping (RG) scheme which shares Replicas in large and reliable groups of nodes, whereas OTOO and RN only share replicas among neighboring nodes. The basic idea of the RG scheme is that it always picks the most suitable data items to replicate on the most suitable nodes in the group to maximize the data availability and minimize the data access delay within the group. The RG scheme can reduce the number of hops that the data need to be transferred to serve the query.

V. 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 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. Here by using three different techniques we are balancing the trade-off between query delay and data availability in MANET's.

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