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An Energy Efficient Data Replication Scheme for Improving Data Availability and Controlling Query Delay in MANET

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***Abstract*: A mobile ad-hoc network (MANET) is a self-organizing and rapidly deployable network which consists of mobile nodes without infrastructure. All nodes are capable of moving actively and can be connected dynamically. It is utilized in numerous applications like video conferencing, rescue operations, military applications, Disaster Management etc. So the information sharing in network play an important role. In order to ensure the effective data sharing in MANET, the data replication is needed. The main aim of the work is to develop the energy efficient data replication algorithm to balance the Query delay, energy consumption and data availability in MANET. Due to the dynamic nature nodes are move freely; therefore link and node failures are common. This leads to frequent network partition in MANET, while the partition occurs the mobile nodes in one partition are not able to access the data hosted by nodes in the other partition. Hence it degrades the performance of the data access. Existing strategies aims at equalisation trade-off between question delay and information convenience. The proposed method focuses on balancing between the node's energy consumption, data availability and delay. By simulation results show that the planned theme achieves higher performance than the present strategies.**

***Keywords*: Replication, energy consumption, delay and data availability**

1. Introduction

MANET mobile nodes are move freely, while network partition occurs. Nodes in one partition cannot access knowledge command by nodes in alternative partitions. Therefore it reduces the performance of the data access. Data replication has been widely used to improve data availability in distribute systems. So data replication scheme is apply in MANETs [1], when replicating data at mobile nodes which are not the owners of the original data. Data availability is being improved because there are multiple replicas in the network and also it reduces the query delay because mobile nodes can attain the data from some nearby replicas. Using data replication it improves the data availability and reduces the query delay in MANET. Consequently, [2] in addition each time it has to request from the neighboring nodes, so it increases the query delay. To solve this problem the energy consumption is consider here for reducing the query delay in MANET. This paper is focus on to improve the energy-efficiency to balance the data availability, query delay, energy.

The Section 1 describes introduction about data replication scheme in MANET, and also discusses the problems in the scheme. Section 2 deals with the previous work. In section 3 is describes for the implementation of an energy efficient scheme. Section 4 describes the performance analysis and also the last section concludes the work.

A. Data replication scheme

Data replication (it stores the same data on multiple storage devices) is used in the Web environment and distributed database systems [1]. Either don't think about the storage constraint or ignore the link failure issue. For addressing these issues a new data replication schemes was introduced. In a MANET, mobile nodes collaboratively share the data.

Multiple nodes exist within the network and that they send analysis requests to alternative nodes for a few specific knowledge things. Each node creates replicas (it is an exact copy of real data (the same but fake)) of the data items and maintains the replicas in its memory or disk space. During the data replication there is no central controller that determines the allocation of replicas and nodes determine the data allocation in a distributed manner.

B. Issues in data replication techniques

Data replication technique [3], for MANET must also deal with the following additional issues.

Server Power consumption: Servers in mobile adhoc network run on battery power. Power consumption of servers to make available database management system; services to potentially many clients should be minimized to the extent that possible. Servers among higher power availability are expected to perform more work than those that contain lower power. If a server have low power remaining and if it is replicated with many frequently accessed data items, then frequent data access requests for these hot data might reduce its power soon. Servers with no power remaining would unable to complete.

Server mobility: Servers in Manet area unit mobile and therefore the speed at that the topology changes is higher. Due

to their quality, servers might sometimes move to a place where they cannot be reached by other servers or clients. Data replication technique is supposed to avoid replicating frequently accessed data items.

Network Partitioning: because of frequent disconnection of mobile hosts, network partitioning occurs. It reduces data accessibility.

Client mobility: Clients query sometimes sends to the nearest servers to get a faster response. The choice to replicate a data item in a particular server may be based on the access frequency of that data item on that server. Clients, after issue their requests for data access to a server might move to new positions after a certain interval of time, and they force to send their query and update requests to the nearby servers from their new locations. Therefore, the access frequencies must be dynamic in nature and the decision to replicate data items.

Client Power: consumer machines additionally run exploitation their battery power. Some client's like servers. They are limited by the amount of energy they can use before their batteries need to survive recharged. A client force loses its power rapidly if it waits for its transactions results for a time-consuming. The replication technique should be capable to replicate data items in appropriate servers in such a way that client power consumption is reduced.

Time critical applications: MANET applications like rescue and military operations are time critical and may contain both in firm and soft real-time transactions. Therefore, the replication technique ought to be able to deliver correct info before the termination of dealing deadlines.

C. How the data replication technique improves the data availability in MANETs

Data availability means where the availability ensures that the data can be successfully transmitted from the source to the destination in a timely manner [8]. Data Replication is technique which reinforces knowledge accessibility by creating copies of information things. Data Replication allows improved data sharing. It is a key move toward for achieving high availability. It is suitable to develop the response time of the access requests.

D. Example for data replication technique

Figure 1 is an example of how data replication can be used to improve the performance of data access when network partition occurs. There are four mobile nodes in the network [1]. $N4$ is a web camera, which continuously records video clips in $d1$ surroundings. Two client's $N1$ and $N2$ sporadically access these video clips by using $N3$ as relay. However, when a disconnection occurs between $N3$ and $N4$ due to a link failure, $d1$ becomes inaccessible to the other three nodes. To improve data availability, a copy of $d1$ can be replicated at $N3$ before the disconnection. Then both $N1$ and $N2$ can access $d1$ still if they are not able to connect with $N4$.As a result of replicating a copy of $d1$ at $N3$, $N1$ and $N2$ can access d contained by one hop, reducing the query delay in the network.

Fig. 1. Network partition due to link failure in a MANET

2. Related works

Several researchers have investigated the area of Data replication techniques in MANET. In this section, we have a discussion of their works.

Mohammed et al. [2] proposed replication scheme to achieve better data consistency, and its accuracy with reduced delay and overhead.

Effective Replica Allocation in Ad Hoc Networks for Improving Data Accessibility Hara [4] proposed three replication techniques. These techniques is for data items are to be replicated on which mobile hosts is based on data items access frequencies and such a decision is taken during a certain period of time, known as relocation period.

According to HARA [5] proposed an assuming an environment where each data item is periodically updated, Three replica allocation methods are proposed to improve data accessibility by replicating data items on mobile hosts. In these three methods, the access frequency from mobile hosts to all data item, the status of the network connection, and the time remaining pending each item is updated next.

Takahiro Hara [6] proposed in MANET there are many applications in which mobile users share information, for e.g., collaborative rescue operations at a disaster site and exchange of word-of-mouth information in a shopping mall. In support of such applications, improving data availability is a considerable issue and various studies have been conducted with this aim. On the other hand, each of these conventional works assumed a particular mobility model and did not fully investigate the influence of the mobility. In this paper consider of several factors that affect the data availability.

According to Nishant Gupta [7] proposed an efficient data replication technique for Mobile Ad-hoc networks is proposed that improve data availability by considering all the issues related with MANET such as power consumption, resource accessibility, and response time and consistency management. Hence this replication technique makes data replication effective as it replicate data items on the basis of access frequency of data items, recent network topology and stability of wireless links. Its improved response time and maintained consistency.

P.Muklian and A.wahi [8] proposed consistency based data replication algorithm with minimum energy consumption and provide high data availability to the multiple mobile nodes whenever required. In the proposed method is focus on improving data accessibility, energy constraint and network

strength.

Morteza Maleki et al. [9] presents a life time prediction scheme to maximizes the network lifetime by finding routing solutions that minimize the variance of the remaining energies of the nodes in the network.

L. Yin and G. Cao [10] proposed data replication techniques for reducing the query delay and improving the data accessibility in MANET.

Moon et al. [11] introduced an energy efficient eager replication scheme, named E-DRM (eager replication extended database state machine), that contain energy restrictions and achieve data consistency across the network reducing the number of broadcast messages.

Paul et al. [13] proposed to solve the problem, an efficient storage space allocation approach the replication problem while nodes are in selfish behaviors. 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.

A. Motivation of research

In MANET, mobile nodes are moving freely, this leads frequent network partition. The communication failure between two or more mobile nodes divides the network, this leads to data inconsistency. The existing intends to improve the reliability between the nodes. Therefore it calculates the access frequency between the neighboring nodes. But the problem is each time it has to retrieve the information for the neighboring nodes; hence it increases the query delay. So energy is calculated each time automatically between the nodes.

3. Implementation of energy efficient data replication [EEDR] scheme

In data replication scheme the main issues are link failure and storage constraints. However the link is reliable, cooperation improves the data availability and also increases the query delay. The problem occurs when replicating the data, because there only limited battery. If a node with less power is replicated with many frequently accessed data items, it soon gets exhausted and it cannot provide services at all. To improve the data availability by considering all the issue related with MANET such as power consumption, resource availability, and response time and also reduces the delay.

A. EEDR scheme

In order to ensure [13] an effective data sharing, the data replication is needed. The main aim of the work is to develop the efficient energy scheme based on data replication technique to balance the Query delay, energy consumption and data availability in MANET. Every mobile node is battery power-driven. If the energy is reduced, then the node will be disconnected from the network. To predict the energy consumption that the transmit power is fixed. So the energy is predicted for each operations is given by,

$$E(\text{packet}) = m * (\text{packet\_size}) + n \quad (1)$$

m and n are coefficients for each operation. Coefficient m denotes the packet size and n is a fixed cost that accounts for acquiring the channel.

B. Calculate remaining energy between the neighboring nodes

Each node calculates the remaining energy of its neighboring node received during the last two communication and the related communication times.

Assume the remaining energy, of a neighbor node at time tA and tB are remenrA and remenrB. The determination of remaining energy [remenr] of this node at time t is given by,

$$\text{remenr} = \text{remenrB} + [(\text{remenrB} - \text{remenrA}) / (\text{tB} - \text{tA})] * (\text{t} - \text{tB}) \quad (2)$$

Every node has to determine the remaining energy by itself and send it to its neighbor's nodes.

C. Reliability ratio

The network partition occurs to node mobility and power off. So the Energy Reliability Ratio (ERR) is calculated.

Energy Reliability ratio (ERR) = percentage of node remaining energy * disconnection period (3)

For example if the worth of ERR=0.5 then link stability between two nodes is 50%. It shows that energy efficiency between the nodes going disconnect from that network. So on that time it replicate data item in neighboring node in the network.

4. Performance analysis

We use NS2 to simulate in our proposed scheme. In our simulation, 50 mobile nodes move in a 1000 meter x 1500 meter square region for 100 seconds simulation time. The simulated traffic is Constant Bit Rate (CBR). Our simulation Settings and parameters are summarized in Table 1.

Table 1
Simulation result

MAC Type	MAC 802.11
Radio Propagation Model	Two Ray Model
Radio Propagation Range	250m
Pause Time	0s
Max Speed	4m/sec-24m/sec
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR
CBR Rate	512 bytes x 6 per second
Number of Connections	50

A. Performance metrics

Evaluate the performance metrics such as query delay, no of hop, bandwidth, packet delivery and data availability in MANET when replicating the data. EEDR scheme is compare with BTDQ and GREEDY.

1) Delay

In Fig. 2, EEDR reduces the delay compared to the GREEDY

SCHEME and BTDQ.

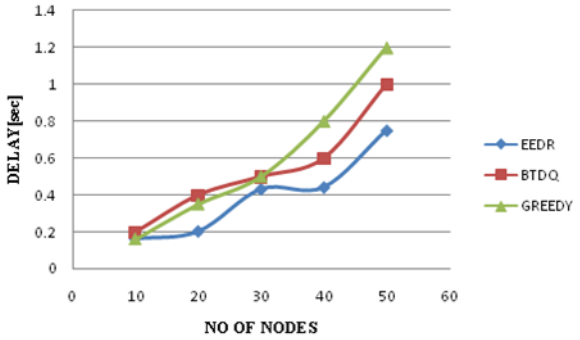

Fig. 2. Comparing results with delay vs. No. of nodes

2) Packet delivery

In Fig. 3, shows the delivery ratio is HIGH in the EEDR SCHEME as compare to the BTDQ and GREEDY SCHEME.

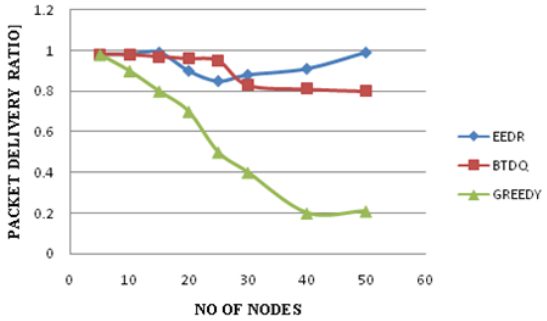

Fig. 3. Comparing results with packet delivery vs. No. of nodes

3) Data availability

In Fig. 4, the data availability is INCREASED in the EEDR SCHEME, when compared to the GREEDY SCHEME and BTDQ.

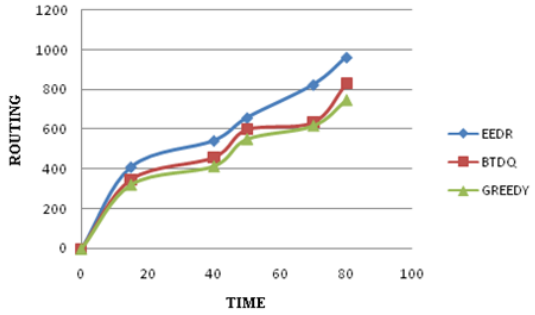

Fig. 4. Comparing results with data availability vs. time

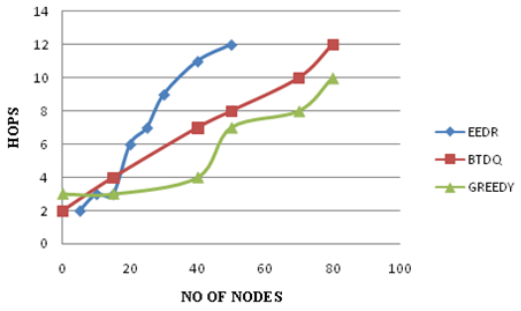

Fig. 5. Comparing results No. of hops vs. No. of nodes

4) No. of hops

In Fig. 5, shows the number of hops is REDUCED IN EEDR when compared to the GREEDY SCHEME and BTDQ.

5) Bandwidth

In Fig. 6, shows the TOTAL BANDWIDTH for processing is DECREASED in the EEDR SCHEME, but it is also INCREASED in the BTDQ and GREEDY SCHEME.

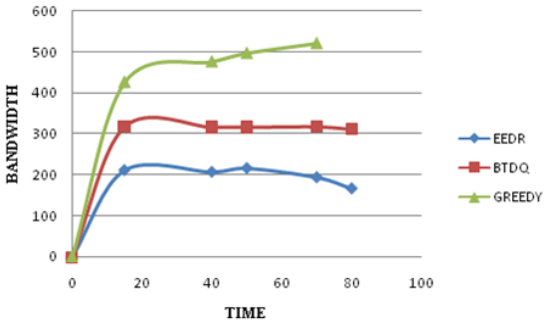

Fig. 6. Comparing results with bandwidth vs. Time

5. Conclusion

MANET is capable of moving active and can be connected dynamically. The data sharing in network play an important role. In order to ensure an effective data sharing, data replication method is needed. The main aim of this work is to develop an energy efficient data replication scheme to reducing energy consumption. Existing methods balance the query delay and data availability. The proposed scheme focuses on balancing energy consumption, data availability and delay. As comparing to the existing methods, proposed scheme achieve high throughput, availability and delivery ratio, also reduces the delay and energy. The simulation result shows that the proposed scheme achieves better performance than the existing methods.

References

[1] ang Zhang et.al, “Balancing the Trade- Offs between Query Delay and Data Availability in MANETs”, IEEE Transactions on Parallel and Distributed Systems, April 2012,

[2] Mohammed Qayyum, Mohammed NoorullahKhan,“Distributed Database Systems MANETS”

[3] Prasanna Padmanabhan Le Gruenwald Anita Vallur Mohammed Atiquzzaman “A survey of data replication techniques for mobile ad-hoc network databases”.

[4] T. Hara, “Effective replica allocation in ad hoc networks for improving data accessibility”, in: Proceedings of IEEE Infocom 2001 (2001) pp. 1568–1576.

[5] Takahiro Hara “Replica Allocation Methods in Ad Hoc Networks with Data Update” 2003 Kluwer Academic Publishers

[6] Takahiro Hara “Quantifying Impact of Mobility on Data Availability in Mobile Ad Hoc Networks” IEEE Transactions on Mobile Computing, February 2010

[7] Nishant Gupta “Efficient Data Replication Algorithm for Mobile Ad-Hoc Networks” IACSIT Press, 2011.

[8] P.Mukilan , A.Wahi “Consistency based Data Replication Algorithm for MANET” IJCA, August 2012

[9] Morteza Maleki, Karthik Dantu, and Massoud Pedram, “Lifetime Prediction Routing in Ad Hoc Networks “wireless Communication and Networking Conference, 2003.

[10] L. Yin and G. Cao. Balancing the tradeoffs between data accessibility and query delay in ad hoc networks. IEEE International Symposium on Reliable Distributed Systems, pages 289–298, 2004.
[11] A. Moon, H. Cho, "Energy efficient replication extended database state machine in adhoc network", International Conference on Applied Computing, 2004.
[12] A. Christopher paul, C.Chandru Vignesh S. Karthik, "Reputation-Based Storage Space Allocation for Balancing the Tradeoffs between Data Availability and Query Delay in MANET". International Journal of Advanced Research in Computer Science and Software Engineering August 2012.
[13] P. Mukilan and A. Wahi "EENMDRA: Efficient Energy and Node Mobility based Data Replication Algorithm for MANET" IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 3, No 1, May 2012.