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# **One to One Optimization (OTOO) Technique used in MANET's to Balance Trade-off between Data Availability and Query Delay**

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ABSTRACT: As the importance of computers in our daily life increases it also sets new demands for connectivity. A Mobile Ad Hoc Network, also called MANET, is a collection of mobile interconnected nodes. In a MANET, the network topology can change unpredictably during data transmissions. In Mobile Ad hoc Networks (MANETs), nodes move freely and link/node failures are common, which leads to frequent network partitions. Due to this the data accessibility process in network leads to data unavailability. Normally node access data from another node, which requires query transmission process i.e. 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. 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. To deal with this problem, data replication techniques are applied to the proposed 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. As both metrics are important for mobile nodes, the paper proposes schemes to implement tradeoffs between data availability and query delay under different system settings and requirements. To overcome this problem some of the following techniques are implemented: The One-To-One Optimization (OTOO) scheme, the Reliable Neighbour (RN) scheme and Reliable Grouping (RG) scheme. In OTOO scheme, each node will replicate the data of the most neighbour data item. In RN scheme each node will replicate the data item of one neighbour 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. This paper proposes OTOO technique.

KEYWORDS: MANET; Data availability; Query delay; OTOO.

#### I. INTRODUCTION

Nodes in MANET have limited battery power and these batteries cannot be replaced or recharged in complex scenarios. To prolong or In Mobile Ad-hoc Networks (MANETs), since mobile nodes move freely, network partition may occur, where nodes in one partition cannot access data held by nodes in other partitions. Thus, data availability (i.e., the number of successful data accesses over the total number of data accesses) in MANETs is lower than that in conventional wired networks. Data replication has been widely used to improve data availability in distributed systems, and it is applicable to MANETs. By replicating data at mobile nodes which are not the owners of the original data, data availability can be improved because, there exists 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. 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. By taking these issues into consideration, we expect that mobile nodes should not be able (or willing) to replicate all data items in the network. One solution to improve the data access performance considering the resource constraints of mobile nodes is to let them cooperate with each other; i.e., 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 also 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



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availability, nodes should not replicate the same data that neighbouring 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 neighbours. Although the delay of accessing the data from neighbours is shorter than that from the data owner, it is much longer than accessing it locally.

A new data replication technique to address query delay and data availability issues is proposed. As both metrics are important for mobile nodes, proposed technique balances the tradeoffs between data availability and query delay under different system settings and requirements. The **OTOO**schemecan achieve a balance between these two metrics and provides efficient system performance. The major advantage of OTOO is, it offers low query delay, high data availability and cooperation between the neighboring nodes.

#### II. RELATED WORK

#### [1] An Optimum Query Delay and Efficient Data Access in MANETs.

JoslinAnie Abraham, Dr. C.D. Suriyakala

Generally, network partition in Mobile Ad-hoc network causes link/node failure. Mobile Ad-hoc Networksnode shares the data through collaborative behaviour, which means that dataaccessing from one node to the other isthrough query transmission process. Partitioning of networks will make a delay for providing requested data to nodes. This may affect the network performance like data sharing. The paper highlights number of data replication techniquesthat will either improve the data availability or reduce the query delay, but not both.

### [2] A Survey of Data Replication Techniques for Mobile Ad-hoc NetworkDatabases

### PrasannaPadmanabhan, LeGruenwald, Anita Vallur, Mohammed Atiquzzaman

The paper identifies issues involved in MANET data replication and attempts to classify existing MANET data replication techniques based on the issues they address. The attributes of the replication techniques are also tabulated to facilitate a feature comparison of the existing MANET data replication works. Parameters and performance metrics are also presented to measure the performance of MANET replication techniques. In addition, the paper also proposes criteria for selecting appropriate data replication techniques for various application requirements.

#### [3] Exploring Group Mobility for Replica Data Allocation in aMobileEnvironment.

Jiun-Long Huang, Ming Syan Chen

The paper addresses the problem of replica allocation in a Mobile Ad-hoc network by exploring group mobility. Analyse the group mobility model and derive several theoretical results. In light of these results, a replica allocation scheme to improve the data accessibility is proposed. Several experiments are conducted to evaluate the performance of the proposed scheme. The experimental results show that the proposed scheme is able to not only obtain higher data accessibility but also produce lower network traffic than prior schemes.

### [4] Distributed Data Replication (DDR) in MANET.

A. Akila

Data replication technique is a method which pacts with the smooth trade-off between data availability, data collision and query delay. Existing data replication techniques pact with any one of the following: reducing the query delay, improving the data accessibility and data collision. To overcome this problem, distributed data replication technique is proposed. Simulation result shows the proposed replication technique which can achieve both query delay and data accessibility with higher performance when compared to the existing technique.

#### [5] Data Consistency for Co-operative Caching in Mobile Environments

P. Nithiyalakshmi, V. Udhaya Kumar

Mobile Ad-hoc Networks (MANETs) have autonomous nodes that can change location itself on the fly. Nodes move spontaneously and node failures are common, which pointers to common network partitions. When a network is partitioned one part of mobile nodes can't access data hosted by nodes in another part of partition, so the performance of data access is reduced. To manage this kind of problem, we propose data replication technique. Existing data replication technique can deal with any one of following: reducing the query delay, improving the data accessibility and data collision. The paper propose a mechanism called data replication technique to deal smooth trade-offs between data availability, data collision and query delay. Simulation result shows that proposed replication technique can achieve both query delay and data accessibility with higher performance.



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#### III. PROPOSED ALGORITHM

The project has been implemented by dividing whole project into five modules as listed below:

- 1. Neighbor Node Identification and Delay Calculation
- 2. Server Route Identification
- 3. Data Served from Server
- 4. One To One Optimization (OTOO)
- 5. Data Served from Cache

#### Neighbour Node Identification and Delay Calculation

- In this module following steps are being followed:
  - Broadcast the ECHO packets in the network and broadcasted time is noted.
  - The active nodes in the network will ECHO back the packets
  - The acknowledged time is noted.
  - Delay is calculated with respect to broadcasted and acknowledged time.

#### **Server Route Identification**

In this module the shortest path to sink/server node is identified based on delay being calculated in the previous module.

#### Data Served from Server

In this module the server/sink node provides a download link of resources available in the server for the nodes being connected to the server and is displayed on client systems.

#### The One-To-One Optimization (OTOO)

The OTOO scheme works as follows:

- All nodes are marked as "white" initially, which means that no one has executed the allocation process yet. These nodes broadcast their *ids* and their access frequency for each data item.
- Among the white nodes, the node which has the smallest *id* among its neighboring white nodes starts the following process. It sends an invitation to the neighboring white node with which it has the lowest link failure probability (P). If the neighbor only receives one such invitation, these two neighboring nodes calculate the P values and each node allocates data items with the highest P values until it cannot accommodate more data. Then both nodes are marked as "black" and no longer participate the replication process until the next allocation period.
- Two or more nodes may start the process at the same time. As long as they do not pick the same node as the most reliable neighbor, they can allocate their replicas at the same time. Otherwise, the node picked by more than one neighbor only accepts the invitation from the node with the lowest *id*. All other inviting nodes have to select another neighbor again.
- If all neighbors of a white node are black nodes, which mean that this white node cannot find any neighbor to cooperate in the allocation process, it only allocates its own most interested data items to its memory.

#### Data Served from Cache

In this module the, if a request is made for a file that has already being downloaded and cached in nodes, then file will be served from cache instead of accessing from server.

#### IV. PSEUDO CODE

The OTOO scheme optimizes the data to be cached between the nodes. This is one of the most efficient optimization schemes for the Data Replication used in the MANET's. The working of OTOO scheme is briefed in section III and the pseudo code for OTOO scheme is as follows:

Step 1: Initially caches are empty Step 2: if (CooperativeNodeCache(Empty))

• return true //select that node for sharing of data



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• Else return false

Step 3: Divide data into 2 parts

- Client will cache one part2 of data
- Other part1 is cached to the cooperative node

Step 4:AccessTime will hold the time when file will be last accessedStep 5: AccessCount will hold the number count of file accessedStep 6: Every time when file is accessed, the AccessTime and AccessCount will be updatedStep 7: Sort the CacheLog depending on AccessTime

Step 8: If(CacheMemory> 90)

- Delete the least accessed data depending on AccessCount
- If many files have same AccessCount, check for the AccessTime and delete thefile which is accessed earlier
- The node which deletes the part of cached file will ask its cooperative node to delete the other part of the same file. Make the remaining cache memory available for data storage.

Step 9: If(No Cooperative Node Available)

• The client tries to cache the entire data

#### V. RESULTS

4 PC's are connected in a network to show that proposed schemes can achieve a balance between the two metrics i.e., data availability and query delay in MANET's and provide satisfying system performance. The snapshots of the project are as shown below with description.

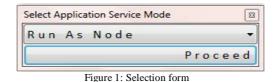


Figure 1 is selection form that appears when the application is executed. Here the application is executed by selecting as node form.

Rout	e Service	e Setting	Neighbor Log	Route Log	
My System Ip	Nexthop Ip	Cache Ip	Neighborlp	Distance	LastUpdateTime
192.168.1.6					
		(In Seconds)			
Remot	e Sink Ip				
	Cache Se	tting			
Max Size (Inf	Bytes)	2048			
Cache Usage	(In %)	0%			
	Start Servi	ice			
erver Files	Cached Files	Service Log			
SINo FileNam	ne	FileSize	FileType	LastModifie	edTime

Figure 2: Node form



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Figure 2 shows the node form that appears when node in selection form is selected.

Run	As	Sink	
			Proceed

Figure 3: selection form

Figure 3 is selection form that appears when the application is executed. Here the application is executed by selecting as sink form.

Balancing th	e Tradeoffs betwee	n Query Delay and I	Data Availability in M	MANETs		E 23
			Service Se	etting		
	My System Ip	192.168.1	.6			
Browse Se	ervice Directory	D:\Downloads	pro image		Br	owse
			Start Sei	rvice		
Service Files	Service Log	Route Log				
SINo FileN	ame		FileSize	FileType	LastModifiedTime	



Figure 4 shows the node form that appears when sink in selection form is selected.

Balancing the	Tradeoffs betwee	n Query <mark>D</mark> elay and I	Data Availability in I	MANETs		<u>−</u> Ξ Σ
			Service S	etting		
	My System Ip	192.168.1	.6			
Browse Se	rvice Directory	D:\Downloads	pro image			Browse
_			Start Sei	rvice		
ervice Files	Service Log	Route Log				
SINo FileNa	ame		FileSize	FileType	LastModifiedTime	

Figure 5: Sink form1



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Figure 5 shows sink form in which path has been selected from which files will be loaded

Balan	icing the	Tradeoffs between	Query Delay and Dat	a Availability in MA	NETs			23
			S	ervice Set	ting			
		My System Ip	192.168.1.6					
Brov	wse Sen	vice Directory	D:\Downloads\pr	o image			Browse.	
		_		Stop Serv	ice			
Servic	e Files	Service Log	Route Log					
SINo	FileNa	me		FileSize	FileType	LastModifiedTime		
1	36a35	1808ff6af2be8d	da0004ca25a0	2 KB	JPEG image	5/5/2014 10:15:45	PM	
2	f8f71d	46eb2c7 <mark>194</mark> ae	959f2573b3abe	2 KB	JPEG image	5/5/2014 10:17:38	PM	
3	hh.zip			36 KB	Compressed	5/5/2014 10:25:25	PM	
4	image	5.jpg		2 KB	JPEG image	5/5/2014 10:18:11	PM	
5	image	s1.jpg		962 Byte(s)	JPEG image	5/5/2014 10:13:04	PM	
6	image	s11.jpg		2 KB	JPEG image	5/5/2014 10:18:32	PM	
7	jfl864d	e3fb3520_mys	pace.jpg	2 KB	JPEG image	5/5/2014 10:19:21	PM	
8	pani-b	utterfly.jpg		3 KB	JPEG image	5/5/2014 10:19:40	PM	
9	produc	timage.php.jpg	1	2 KB	JPEG image	5/5/2014 10:19:58	PM	
10	quality	jpg		2 KB	JPEG image	5/5/2014 10:20:12	PM	

Figure 6: Sink form2

Figure 6 shows sink form with files being loaded.

	Route Service Se	tting	Neighbor Log	Route Log		
My S	ystem Ip Nexthop Ip (	Cache Ip	Neighborlp	Distance	LastUpdateT	ime
E.	2.168.1.16 192.168.1.8		192.168.1.17	289.0625	5/6/2014 5:3	9:12 PM
			192.168.1.8	539.0625	5/6/2014 5:3	9:12 PM
	Itteration Delay 🛛 10 💲 (In	Seconds)	192.168.1.15	789.0625	5/6/2014 5:3	9:13 PM
	Remote Sink Ip 192.16	8.1.8				
	Cache Settin	g				
Ma	ax Size (InBytes) 20	048 🛟				
Ca	che Usage (In %)	0%				
	Stop Service					
Serve	er Files Cached Files Serv	rice Log				
SINo	FileName	FileSize	FileType	LastModifie	dTime	
1	36a35d808ff6af2be8cda0	2 KB	JPEG image	5/5/2014 11	L:27:58 PM	Download
1.		- An index of the second		all a digen and a second		
	5_opt.jpg	2 KB	JPEG image	5/5/2014 11	L:30:09 PM	Download
2	5_opt.jpg av.txt	2 KB 10 Byte(s)	JPEG image Text Document	5/5/2014 11 4/30/2014 4		Download Download
2 3					1:34:24 PM	
2 3 4	av.txt	10 Byte(s)	Text Document	4/30/2014 4	1:34:24 PM 21:13 PM	Download
2 3 4 5	av.txt cc.txt	10 Byte(s) 29 Byte(s)	Text Document Text Document	4/30/2014 4 5/5/2014 4:	1:34:24 PM 21:13 PM 3:27:46 PM	Download Download
2 3 4 5 6 7	av.txt cc.txt cohen.cbp	10 Byte(s) 29 Byte(s) 1 KB	Text Document Text Document project file	4/30/2014 4 5/5/2014 4: 5/27/2013 8	1:34:24 PM 21:13 PM 3:27:46 PM 1:27:58 PM	Download Download Download

Figure 7: Node form1

Figure 7 shows node form being loaded with download link of files in the server.



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Save As						? 🛛
Save jn:	🞯 Desktop		~	00	• 🖾 🍤	
My Recent Documents Desktop My Documents My Computer	My Documents My Computer My Network Pl Balancing_Que Old	laces eryDelay_DataAvailibility				
	File <u>n</u> ame:	av			~	Save
My Network	Save as type:	TXT Files (*.txt)			~	Cancel

Figure 8: save form

Figure 8 shows the form showing path to select in which downloaded file will be saved.

Downloa	d Server File	
<b>I</b>	Successfull!! File Downloaded Succ	essfully
	ОК	

Figure 9: successful download form

Figure 9 is the form that will be shown when file is downloaded successfully.

	Route Service Settin	g	Neighbor Log	Route Log	
My Sy	stem Ip Nexthop Ip Cache	Ip .	Neighborlp	Distance	LastUpdateTime
192	.168.1.16 192.168.1.8 192.	168.1.8	192.168.1.8	265.625	5/6/2014 7:19:19 PM
152		100.1.0	192.168.1.15	765.625	5/6/2014 7:19:20 PM
	Itteration Delay 10 😂 (In Second	ls)			
	Bemote Sink Ip 192,168,1,17				
	Remote Sink Ip 192.168.1.17				
	Cache Setting				
Ma	x Size (InBytes) 3072	*			
Car	che Usage (In %) 24%				
Cat	.ne Osage (m /o) 24/0				
		7			
	Stop Service				
Servei	Stop Service				
	P	og FileSize	PartId	AccessCount	AccessTime
	r Files Cached Files Service Lo	- I		AccessCount	AccessTime 5/6/2014 7:19:13 PM
SINo	r Files Cached Files Service Lo FileName	FileSize		1	
SINo 2	Files Cached Files Service Lo FileName cohen.cbp	FileSize 739	PART2	1	5/6/2014 7:19:13 PM
SINo 2	Files Cached Files Service Lo FileName cohen.cbp	FileSize 739	PART2	1	5/6/2014 7:19:13 PM
SINo 2	Files Cached Files Service Lo FileName cohen.cbp	FileSize 739	PART2	1	5/6/2014 7:19:13 PM
SINo 2	Files Cached Files Service Lo FileName cohen.cbp	FileSize 739	PART2	1	5/6/2014 7:19:13 PM

Figure 10: cache utilization form

Figure 10 shown files being cached and also cache being utilized.



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FileName     FileSize     PartId     AccessCount     AccessTime       i     productimage.php.jpg     815     PART2     1     5/6/2014 7:21:25 PM       i     images11.jpg     866     PART2     1     5/6/2014 7:20:51 PM	192.168.1.16   192.168.1.8   192.168.1.8   192.168.1.8   192.168.1.8     192.168.1.16   192.168.1.8   192.168.1.8   192.168.1.15   765.625   5/6/2014 7:21:39 PM     Itteration Delay   10 (m Seconds)   192.168.1.17   765.625   5/6/2014 7:21:40 PM     Cache Setting     Max Size (InBytes)   3072   1000   1000   1000   1000     Cache Usage (In%)   87%     Stop Service     Sitop Service <td <="" colspan="2" th=""><th>192.168.1.16   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.15   765.625   5/6/2014 7:21:30 PM     Itteration Delay   10 © (In Seconds)   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Remote Sink Ip   192.168.1.17  </th><th></th><th>Route Service Settin</th><th>۱g</th><th>Neighbor Log</th><th>Route Log</th><th></th></td>	<th>192.168.1.16   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.15   765.625   5/6/2014 7:21:30 PM     Itteration Delay   10 © (In Seconds)   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Remote Sink Ip   192.168.1.17  </th> <th></th> <th>Route Service Settin</th> <th>۱g</th> <th>Neighbor Log</th> <th>Route Log</th> <th></th>		192.168.1.16   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.8   265.625   5/6/2014 7:21:39 PM     192.168.1.16   192.168.1.8   192.168.1.15   765.625   5/6/2014 7:21:30 PM     Itteration Delay   10 © (In Seconds)   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Remote Sink Ip   192.168.1.17		Route Service Settin	۱g	Neighbor Log	Route Log	
192.168.1.16   192.168.1.8   192.168.1.8   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Itteration Delay   10   (In Seconds)     Remote Sink Ip   192.168.1.17     Cache Setting     Max Size (InBytes)   3072     Cache Usage (In %)   87%     Stop Service     FileSize   Partid   AccessCount   AccessTime     productimage.php.jpg   815   PART2   1   5/6/2014 7:21:25 PM     Sitop Service	192.168.1.16   192.168.1.8   192.168.1.8     Itteration Delay   10 (in Seconds)     Remote Sink Ip   192.168.1.17     Cache Setting     Max Size (InBytes)   3072     Cache Usage (in %)   37%     Stop Service     FileSize     Partid   AccessCount     Sino   FileName     FileName   FileSize     Sop Garchaepsperize   Partid     AccessCount   AccessTime     Singes11.jpg   866     PART2   1   5/6/2014 7:20:28 PN     images11.jpg   866   PART2   1   5/6/2014 7:20:51 PN     images11.jpg   708   PART2   1   5/6/2014 7:20:52 PN     images11.jpg   739   PART2   1   5/6/2014 7:20:51 PN	192.168.1.16   192.168.1.8   192.168.1.8     Itteration Delay   10 (In Seconds)     Remote Sink Ip   192.168.1.17     Cache Setting     Max Size (InBytes)   3072     Cache Usage (In %)   87%     Stop Service     FileSize     Stop Service     Silo FileName   FileSize     productimage.php.jpg   815     PART2   1   5/6/2014 7:20:25 PM     4   images11.jpg   866     PART2   1   5/6/2014 7:20:25 PM	My Sys	stem Ip Nexthop Ip Cache	lp	Neighborlp	Distance	LastUpdateTime		
192.168.1.15   765.625   5/6/2014 7:21:40 PM     Itteration Delay 10 (in Seconds)     Remote Sink Ip   192.168.1.17     Cache Setting     Max Size (InBytes)   3072     Cache Usage (In %)   87%     Stop Service     Sitop Service<	192.168.1.15   765.625   5/6/2014 7:21:40 PM     Itteration Delay 10 © (in Seconds) Remote Sink Ip   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Itteration Delay 10 © (in Seconds) Remote Sink Ip   192.168.1.15   765.625   5/6/2014 7:21:40 PM     Cache Setting     Max Size (InBytes)   3072   0     Cache Usage (In %)   87%   0   0     Stop Service     Sitop Service Log     SINo   FileName   FileSize   Partid   AccessTime     5   productimage.php.jpg   815   PART2   1   5/6/2014 7:21:25 PN     4   images11.jpg   866   PART2   1   5/6/2014 7:20:28 PN     3   f8f71d46eb2c7194ae959f257   1008   PART2   1   5/6/2014 7:20:28 PN     3   Z   Zowen.cbp   739   PART2   1   5/6/2014 7:20:28 PN	192.168.1.15   765.625   5/6/2014 7:21:40 PM     Itteration Delay   10 © (In Seconds)     Remote Sink Ip   192.168.1.17     Cache Setting     Max Size (InBytes)   3072   0     Cache Usage (In %)   87%   0     Stop Service     Sitop Service     Sitop Service     Silvo   FileSize   Partid   AccessCount   AccessTime     5   productimage.php.jpg   815   PART2   1   5/6/2014 7:20:25 PM     4   images11.jpg   866   PART2   1   5/6/2014 7:20:25 PM     3   f8f71d46eb2c7194ae959f257   1008   PART2   1   5/6/2014 7:20:28 PM     2   colsen.cbp   739   PAR12   1   5/6/2014 7:20:28 PM	192	169 1 16 192 169 1 9 192	16919	192.168.1.8	265.625	5/6/2014 7:21:39 PM		
Remote sink ip     192.168.1.17       Cache Setting       Max Size (InBytes)     3072       Cache Usage (In%)     87%       Stop Service     Stop Service       Silvo FileName     FileSize     Partid     AccessTome       Silvo FileName     FileSize     Partid     AccessTome       Soft Service     Stop Service     Stop Service       Silvo FileName     FileSize     Partid     AccessTome       Silvo FileName     FileSize     Partid     AccessPoiltor       Silvo FileName     FileSize     Partid     AccessPoiltor       Silvo FileName     FileSize     Partid     AccessPoiltor	Remote Sink Ip     192.168.1.17       Cache Setting       Max Size (InBytes)     3072       Cache Usage (In%)     87%       Stop Service     Service Log       Silvo     FileSize     Partid     AccessCount     AccessTime       5     productimage.php.jpg     815     PART2     1     5/6/2014 7:20:25 PN       4     images11.jpg     866     PART2     1     5/6/2014 7:20:25 PN       3     f8f71d46eb2c7194ae959f257     1008     PART2     1     5/6/2014 7:20:28 PN       2     comen chp     7.39     PART2     1     5/6/2014 7:20:28 PN	Cache Setting       Max Size (InBytes)     3072       Cache Usage (In %)     87%       Stop Service	152.	100.1.10 152.100.1.0 152	.100.1.0	192.168.1.15	765.625	5/6/2014 7:21:40 PM		
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Figure 11: File deleted form

Figure 11 shows form showing files being deleted in cache when cache utilization exceeds 90%.

#### VI. CONCLUSION AND FUTURE WORK

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. A data replication scheme to improve the data availability and reduce the query delay has being implemented. 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 fundamental tradeoff 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.

In future work can done towards improving cooperation between nodes and increasing cache size without effecting the network and also on the parameters which improve the overall system performance. Group Optimization can be used in future instead of One To One to Optimization. In Group Optimization instead of sharing data with one neighbor, sharing of data takes place with group of neighbor nodes. Hence if link failure occurs with one neighbor data will be available with other neighbors.

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