# Broadcast Disk with Adaptive scheduling Technique for Mobile Ad-hoc Networks

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*Abstract*—**A Mobile Ad-Hoc Network (MANET) is a group of wireless, mobile, battery-powered clients and servers that autonomously form temporary networks. Three data communication modes can be provided in a MANET, data broadcast, data query, and peer-to-peer messaging. The objective of this research is to develop a MANET data communication technique, BDAS (Broadcast Disk with Adaptive scheduling), which uses broadcast disk with adaptive scheduling in the data broadcast mode, which handles the mobility issues in broadcasting relevant information without delay. It also reduces the waiting time and battery power of clients. Our proposed Broadcast Disk utilizes maximum of downstream communication capacity of server to provide the client with the needed information with minimum need for Data pull, because Pull-based systems are a poor match for asymmetric communications environments, as they require substantial upstream communications capabilities.**

*Index Terms*—**Broadcast Disk (BD), Access Pattern (AP), Mobile Ad-Hoc Network (MANET), Scheduling.**

## I. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a collection of mobile, wireless and battery powered servers and clients [2]. The topology of a MANET changes frequently as nodes move. A MANET is a potential solution whenever a temporary network is needed and no fixed infrastructure exists. A MANET provides the traditional wireless network capabilities of data push and data pull as well as allowing clients to communicate directly in peer-to-peer communication without the use of a server, unless necessary for routing [1]. Due to servers having a larger capacity than clients [2], we assume that servers contain the complete database management system (DBMS) and bear the responsibility for data broadcast and satisfying client queries.

Nodes (clients and servers) may not remain connected to the MANET throughout their life. To be connected to the network, a node must be able to hear the transmission of at least one other node on the network and have sufficient power to function. Network nodes (clients and servers) may operate in any of the three modes that are designed to facilitate the reduction in power used [3]. Traditional mobile network research must address the limitations of the wireless bandwidth as well as the mobility and battery power of clients. MANET must consider these issues for both clients and servers. This prevents the use of current traditional mobile network data communication protocols, which assume stationary servers with unlimited power. Over the past few years, interest in data communication has been increasing [2], [4], [5].

In many existing and emerging application domains the downstream communication capacity from servers to clients is much greater than the upstream communication capacity from clients back to servers. In a wireless mobile network, servers may have a relatively high bandwidth broadcast capability while clients cannot transmit or can do so only over a lower bandwidth link. Such systems have been proposed for many application domains these environments as Asymmetric Communications Environments (ACE). ACE spans a wide range of important systems and applications, encompassing both wired and wireless networks. Pull-based systems are a poor match for asymmetric communications environments, as they require substantial upstream communications capabilities.

Several applications in a mobile computing environment, such as stock activities, traffic reports and weather forecast, have become increasingly popular in recent years [6].It is noted that mobile computers use small batteries for their operations without directly connecting to any power source, and the bandwidth of wireless communication is in general limited. As a result, an important design issue in a mobile system is to conserve the energy and communication bandwidth of a mobile unit while allowing mobile users of the ability to access information from anywhere at anytime [7]–[9].

To summarize we have chosen the following issues and proposed a technique BDAS (Broadcast Disk with Adaptive scheduling).

1) Broadcast disk with adaptive scheduling in the data push stage of the MANET.
2) Handles the mobility issues in broadcasting relevant information without delay. It also reduces the waiting time and battery power of clients.
3) Server mobility issues over a large geographical Area.

BDAS approach is organized as follows. Section II provides Broadcasting Technique using Broadcast Disk. Mobility Updating Model is discussed in Section III. The Architecture and Adaptive Scheduling algorithm (when the there is a server mobility over a large geographical Area) is discussed in Section IV. Section V describes peer-to-peer

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messaging and data pull stage of MANET. Section VI presents the simulation results of our technique.

## II. BROADCAST DISK

Data is normally pushed from the server to the clients in the Broadcast Disk environment,. A server continuously and repeatedly broadcasts data to the clients. In effect, the broadcast channel turns into a “disk” from which clients can retrieve data gradually. Recently many researchers concentrates on broadcast disk scheduling [13]–[15]. Broadcast Disks exploits communication asymmetry by treating a broadcast stream of data that are repeatedly and cyclically transmitted as a storage device. The broadcast disk technique has two main components. First, multiple broadcast programs (or ``disks'') with different latencies are superimposed on a single broadcast channel, in order to provide better performance for non-uniform data access patterns (AP) and increased availability for critical data. Second, the technique integrates the use of client storage resources for caching and perfecting data that is delivered over the broadcast.

The broadcast is created by conveying data items to different “disks" of varying sizes and speeds, and then multiplexing the disks on the broadcast channel. Objects stored on faster disks are broadcast more often than Objects on slower disks. This approach creates a memory hierarchy in which data on the fast disks are “closer” to the clients than data on slower disks. The number of disks, their sizes, and relative speeds can be attuned, in order to more closely match the broadcast with the desired access probabilities at the clients. If the server has an sign of the client AP (e.g., by watching their previous activity or from a description of intended future use from each client), then hot pages (i.e., those that are more likely to be of interest to a larger part of the client community) can be brought closer while cold pages can be pushed further away.

### A. *Structuring the Broadcast Disk*

In a push-based information system, the server must construct a broadcast “program” to meet the needs of the client population. In the simplest scenario, given a sign of the data items that are preferred by each client listening to the broadcast, the server would simply take the amalgamation of the requests and broadcast the resulting set of data items cyclically. Such a broadcast is depicted in Figure 1.

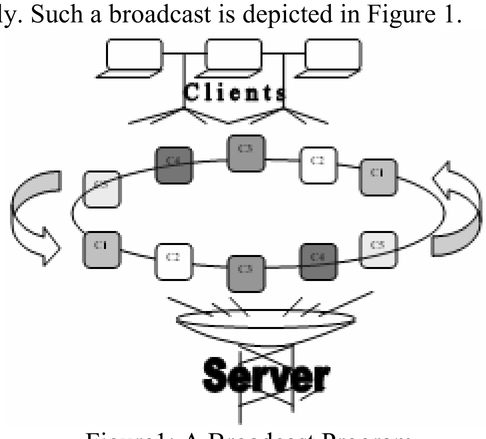


Figure1: A Broadcast Program

When an application running on a client needs a data item, it first endeavors to retrieve that item from the local memory or disk. If the desired item is not found, then the client observes the broadcast and waits for the item to arrive. With the normal broadcast, the predicted wait for an item on the broadcast is the same for all items (namely, half a broadcast period) regardless of their relative importance to the clients. This approach has been espoused in earlier work on broadcast-based database systems such as Data cycle [10] and [11].

Alternatively, the server can broadcast dissimilar items with differing frequency. Such a broadcast program can emphasize the most popular items and de-emphasize the less popular ones. Hypothetically, the generation of such non-flat broadcast programs can be addressed as a bandwidth allocation problem; given all of the client access probabilities, the server determines the optimal percentage of the broadcast bandwidth that should be allocated to each item. The broadcast program can then be generated randomly according to those bandwidth allocations, such that the average inter-arrival time between two instances of the same item matches the requirements of the client population. However, such a random broadcast will not be optimal in terms of diminishing expected setback due to the variance in the inter arrival times.

### B. *Broadcast Technique*

In this section, a Technique for generating broadcast chunks of BD is presented. The algorithm imposes a Multi-disk structure on the broadcast medium in a way that allows substantial flexibility in fitting the relative broadcast frequencies of data items to the access probabilities of a client population.

The Broadcast Technique has the following steps (for simplicity, assume that data items are “pages”, that is, they are of a uniform, fixed length):

$P_v$ → is the Page Vector of all participating pages in the BD
$P_{vs}$ → Sorted Rank of access of $P_v$.
$AP_v$ → Access Pattern Vector of $P_v$
$W_{pv}$ → Weigthage of $AP_v$
$N_d$ → Total Number of Disks,
$N_c$ → Vector of Count of Chunks per disk

$N_c[i] = W_{pv}[i]^{-1}$ , i = 0 to $N_d$
$C_b = \{x: f(x)\}$

Where

$f(x) = C[j]\ [i \bmod Nc[j]\ ]$

Where i =0 to Max ($N_c$) - 1
j =1 to $N_d$

Where $C_b$ is the chunks to be broadcasted. $P_v$ is partitioned into multiple vectors based on Wpv. These vectors are referred to as disks (D).

## III. MOBILITY UPDATING MODEL

In MANET, the nodes (clients and servers) are mobile normally. This mobility causes a node to synchronize its information with other nodes of the network. The synchronization phase allows nodes in the network (both servers and clients) to synchronize and identify the other nodes in their immediate locality. This phase has two stages as

Server Transmission Phase (CTP), Client Transmission Phase (CTP)

*A Server Transmission Phase*

STP is limited to the transmission of information by servers. Servers transmit their unique ID and location. This information is necessary to perform peer-to-peer message routing and is used by clients to choose the nearest server to query during the data query process. During server synchronization all servers are allowed to transmit their information independently for which adequate time is allocated. Before transmitting its information, it should wait for the appropriate period of time, and every server should transmit its information in turn. The number of servers having smaller IDs and the time needed for it to transmit its ID and location are factors to estimate the amount of time a server must wait

*B Client Transmission Phase*

CTP is for transmission of information by client nodes. Every client transmits its unique ID and location to other nodes. To carry out routing of peer-to-peer messages during the data pull phase, the location of each client is required.

Since the number of clients is large, each client may not find adequate time to transmit independently. When the transmission channel is apparent, Clients transmit their information. Synchronization results also be a factor in peer-to-peer communication. Nodes can estimate their disconnection status from the network, during the synchronization phase. A node will sleep until the next service cycle, when it does not notice any other node during synchronization.

In addition to that, the server nodes must restructure their broadcast disk based on the client access patterns received from the other server nodes (of their immediate vicinity). This helps is to provide relevant information to the client nodes. To solve this issue, we have proposed an efficient adaptive scheduling algorithm. The upcoming section discusses the proposed algorithm in detail.

## IV. ADAPTIVE SCHEDULING OF BROADCAST DISKS

The movement of the server over a large geographical area is determined by the change of client ratio for a particular Server. When the number of serving clients of server changes more than a predefined threshold from it's previous service cycle it is assumed that, it is in a new geographic area or the server node has moved to other geographical area. Because of this the server must synchronize to the other server with the AP and the server's AP has to be modified. In this section, we present an adaptive scheduling algorithm which address the issue of satisfying the clients in the immediate vicinity of the server when the server mobiles over a large geographic area.

Assumptions

$S_u$ → Server which needs AP modification (i.e.) server moved over a large geographical area.
$S_c$ → The count of servers which are in the immediate vicinity of the server $S_u$.
$NC_o$ → The number of old clients in server $S_u$.
$NC_n$ → The number of new clients in server $S_u$.
$S_{IV}$ → The server which is present in the immediate vicinity of server $S_u$.
$SCS_{IV}$ → Score returned by $S_{IV}$.
$APS_{IV}$ → Access Pattern returned by $S_{IV}$.

The server $S_u$ broadcast it's unique ID, AP and new clients information to all $S_{IV}$. Each SIV calculates the score of participating clients against the new clients from Su. Then it returns the score and AP of new clients back to $S_u$. The AP of the server $S_u$ is modified from the response received from all $S_{IV}$ as follows.

$$APT_{Su}[j] = \sum_{i=o}^{Sc} APS_{IV}[S_{IVi}] * SCS_{IV}[S_{IVi}] / SP_c \quad , j = 1 \text{ to } N_p$$

$SP_c$ → Count of SIV which contain the APSIV[j]. The $S_{IV}$ which does not contain the AP is not added in the calculation.

$$AP_{Su}[m] = APoc[m] * SCSoc[m] + APT_{Su}[m] / 2$$

APoc is the access pattern of the clients who are still participating with Su ($NC_o$). SCSrc is the Score of APoc. The process is applicable for all the number of servers (m).

$N_p$ → Pattern Length
$AP_{Su}$ → Access Pattern of $S_u$

## V. PEER-TO-PEER MESSAGING AND DATA PULL

Both data query and peer-to-peer messaging take place at the data pull stage. In peer-to-peer messaging, clients transmit data directly to other clients.

In data query, the clients can retrieve the relevant data from the broadcast disk as it goes by. If the client cannot get it's relevant information from broadcast disk, it can retrieve the information by peer-to-peer messaging. If the target client is detected, it will transmit the data directly. Otherwise, a routing request will be sent to a server and finally a client may receive a peer message.

## VI. EXPERIMENTAL EVALUATION

This section deals with the experimental performance evaluation of our algorithms through simulations. In order to test our protocol, The NS2 simulation software [12] is used. NS2 is a general-purpose simulation tool that provides discrete event simulation of user defined networks.

The network nodes were placed uniformly at random within a square of 1000 meters. We varied the average speed of the mobiles from 10, 20, …, 50 in order to study the impact of server mobility. The data broadcast size is varied from 1000, 2000,…, 5000.

In all the experiments, we used the following evaluation criteria:

**Broadcast Effectiveness** which is the ratio of items of interest in a broadcast to the total number of items transmitted.

**Clients Utilization** which is the Percent of clients receiving the broadcast.

**Average Power Consumption** which is the power consumed by clients and the average power consumed by servers.

**End-to-End Delay** which is the delay occurred in broadcasting the data by the server to the clients.

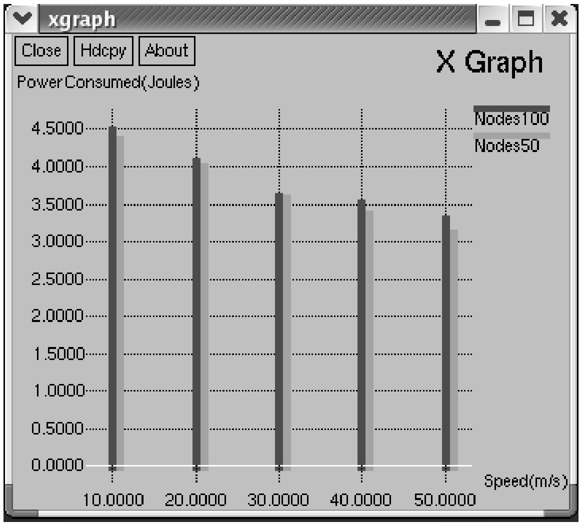


Figure 2: Broadcast Effectiveness Vs ServerSpeed

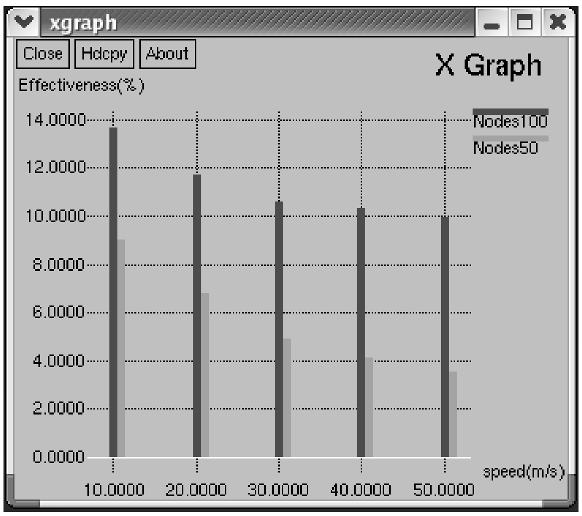


Figure 3: ClientPowerConsumption Vs ServerSpeed

## VII. CONCLUSIONS AND FUTURE WORK

In this paper, we studied the problem of satisfying the client's requests while the server moves into a large network.

We first presented a new Broadcast technique for generating broadcast chunks of Broadcast disk. Then we discussed the impact of server mobility over large data networks and designed a mobility updating model, which allows servers/clients to synchronize and detect the other nodes in their immediate vicinity. Finally we presented the Adaptive Scheduling algorithm of Broadcast Disks, which handles the mobility issues in broadcasting relevant information without delay. We showed through extensive simulations, our proposed protocol reduces the broadcasting delay, waiting time and battery power of clients. An interesting future work is to reduce the cost and delay of the server in fetching AP of new clients from other servers.

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