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Data Dissemination Techniques in Mobile Computing Environment

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ABSTRACT

Generally, data is broadcasted through high downlink channel capacity. The capacity of this channel is very large when compared to the uplink channel capacity. This method is best suited for mobile computing environment. Here the server continuously broadcast and the client listens and downloads the required data. In this scenario, when the client requests the required data, it should be able to access within a minimum time. So, the primary goal of mobile computing is to achieve minimum access time. This paper discusses various research concepts where the readers can proceed with the research work.

Keywords: Access Time, Broadcast Schedule, Push, Pulls, Hybrid, Cache Management, Multi-Channel, Client's Impatience, Multi-Server

I. INTRODUCTION

Most of the research community is paying more attention on mobile computing due to its increasing popularity. There are number of research areas in wireless data dissemination in mobile computing environment. The research includes data broadcasting (scheduling), client cache management, client's impatience, single server broadcasting and multi-server broadcasting. We are going to present different scheduling methods, how cache is managed, how to organize the data on to single channel and on multiple channels to reduce the access time. Discussion on what should be the length of the queue and how to handle impatience clients. Section 2 discusses various scheduling methods. Section 3 presents cache management. Section 4 presents multi-channel data dissemination. Section 5 gives the causes for the client being impatient. Finally Section 6 finds an interesting and new topic for research that is data dissemination using multiple servers. Section 7 concludes the paper.

II. METHODS AND MATERIAL

Data Scheduling

The basic idea behind data broadcasting is that data from single information centre (server) is reached to a large number of receivers (clients).much research is carried for more than a decade. Data include text, images, videotext and graphs. There are basically two methods for data dissemination: point-to-point (interactive) and broadcast. In point-to-point, communication will be between client and server where as in broadcast, data is transmitted periodically through a high bandwidth channel from server where actually the data is dumped to an arbitrary large number of clients.

Generally, data broadcast is broadly classified into two groups: push-based – where the clients need not send a request to the server but the server periodically transmits the available data with it [1,5] and pull based – here clients put on the request for their required data and wait to listen from the server [2,3].

A. Push Scheduling

Researchers have proposed two types of algorithms based on push : periodic and probabilistic. In periodic method data is continuously and repeatedly broadcasted based on the pre-computed optimal schedule. This method guarantees minimum variance which means that the availability of data on the channel is predictable. In probabilistic approach, selection of data to be broadcasted is purely based on the probabilities of requests. The disadvantage of this approach is some data items suffer from starvation. There are many algorithms proposed by researchers: Flat Scheduling [1]: here all the data items are broadcasted using round robin fashion. The access time of each data item is same i.e, half the broadcast cycle. It is simple in its implementation but poor in performance when the access probabilities are skewed

Broadcast Disks : This algorithm is proposed in [1] also called as hierarchical data dissemination. The data items with same range of access probabilities are arranged on the same disk. The items are selected with relative frequencies for broadcasting. Each disk is further divided into chunks and each chunk from disks is broadcasted in a cycle. But here there is a problem in the division of chunks as number of minor cycles will not be equal to the LCM of relative broadcast frequencies. [20] addresses solution to this problem by filling the slot with other relevant information.

Polynomial Approximation : the authors [4] use polynomial time approximation to minimize cost of the schedule which is measured in terms of expected response time and broadcast cost.

Packet Fair Scheduling: this scheduling is defined by Hameed and Vaidya [6,7]. The concept of spacing is introduced for disseminating the data. As the item can appear more than once per broadcast cycle during its dissemination. Two different algorithms are also introduced based on the square root on-line and off-line.

Broadcasting Dependent Data Items : Researchers have given a simple optimal schedule [8] for two files. There exists two classes of clients and the data is accessed by either from single or both classes. Assuming the length of the files is equal they have proposed the schedule. Then the work is extended to variable length and proved that still an optimal schedule exists.

B. Pull Scheduling

Push scheduling reduces the average access time. But there are two disadvantages with the push scheduling: 1) irrespective of the popularity of the data items they are been broadcasted by the server periodically. Thus, causing the wastage of precious bandwidth as non-popular data items re also broadcasted. 2) Average waiting time of the popular data items will be more, if the server has large number data items among which some of them are non-popular. Pull based scheduling considers the clients request giving rise to on-demand pull scheduling. In this method, clients send request for specific data items along the uplink channel to the server. In turn, server will respond not only to the particular client who has put request, but also will satisfy large number of clients who need it. Inspite of overcoming the disadvantages of push scheduling this method too has disadvantages :1) it requires extra channel to receive the requests from the clients. 2) server gets interrupted by client's request. But still this scheduling is used in client/server communication to increase the performance. When clients send request to the server they are queued upon arrival. Then the server selects an item from the queue based on the outstanding requests to broadcast it over the channel and removes the associated request from the queue. Clients try to listen from the broadcast channel and download the required data item. In on-demand, the broadcast schedule will determine which data item has to be fetched from the queue to broadcast it at every instance of broadcast cycle. There are number of algorithms exists under this scheduling There algorithms are classified into two groups.

1. Scheduling equal length data items.
2. Scheduling variable (unequal) length data items.

Scheduling Equal Length Data Items : Here the data items which have to be broadcasted are assured to be of same or equal length. Based on this assumption the following algorithms were proposal.

First Come First Serve (FCFS) : As the name itself says that the item which is request first will be broadcasted first . but it will suffer from poor performance in terms of access time broadcasted.

Most Request First (MRF) : Based on largest number of pending requests of the data item , they are broadcasted. It provides minimum average access time but suffers from fairness.

Based, on these two fundamental scheduling schemes other two are defined: Shortest Time First (STF) and Lowest Waiting Time First (LWTF).

From [8] it is concluded that when the system is lightly loaded, the average access time is much less to the scheduling algorithm used. But as the load of the system increases, most request first results in best scheduling algorithm as it gives less access time , provided that the access probabilities of the items are equal. On the other hand if the access probabilities follow Zipf distribution [23] LWF shows best in its performance and MRFL is very near to LWF. Moreover , LWF is not suitable for the larger systems. As decision over head of recalculating the total waiting time for every item with is pending request has to be taken.

Scheduling Variable Length Data Item : As in the practical system it is true that the data items requested by the clients will not be of equal length. So there is a need to handle the scheduling of data items with variable length. The authors in [3] have investigated and given solution for handling heterogeneous data items. A new metric cached stretch is defined to measure the performance of the heterogeneous systems. Stretch is defined as the ratio of response time of a request to its service time. It states that the smaller jobs will take less service time than the larger jobs. Service time is defined as the time needed to complete the request. Here the service time is considered to the size of the data items. The service time of an item will be equal to the size of an item and it is measured broadcast units. [11] has investigated pre-emptive algorithms in that scheduling is recomputed to broadcast the pause of a data item.

SRTF : Broadcasts the data item with LTSF. The item which is chosen for broadcasting should have largest total time.

MAX Algorithm : Here a deadline is added to each accessing request. The data item which has earliest deadline is chosen to broadcast. Deadline is computed as

$$\text{deadline} = \text{arrival time} + \text{service time} \times S_{\max} .$$

RXW : Similarly FLFS is fair but yields more waiting time. Every page with main RXW values is scheduled for broadcast where R is number of pending requests and W is oldest request in the queue

C. Hydrid Scheduling

As push can't be applicable to large data base system and in pull an extra up link channel for putting request consumes more battery power and if that link is congested then there will be more delay in accessing. So, hybrid scheduling uses the flavors of both push and pull. A hybrid architecture was first investigated in [14,15]. The basic idea here is to divide the data items into two sets: popular (hot) and non- popular (cold). The items with more access probabilities are popular and are meant for using push method where as non-popular use pull method. The authors of [16] identify different factors such as 1) Clients and servers ratio 2) Downlink and uplink channels 3. Total amount of data uploaded and downloaded before taking a decision for broadcasting. Initially the proposed algorithm selects page with lowest p/x ratio is considered for push broad and point-to-point communication for pull scheduling. Then the algorithm is modified as it provides a pull threshold client monitors broadcast channel for t time then if not found sends a request to the server. Thus avoids overloading of pull queue.

In [16], the push-based Bdisk model was extended to integrate with a pull-based approach. The proposed hybrid algorithm provides the clients with the uplink channel to send requests if they are not found in the broadcast channel to the server. To improve the scalability, three different methods are proposed: 1) assign bandwidth to push and pull channels. 2) given a threshold *T*, the client has to monitor the broadcast channel for a period of T before it sends a request to the server using uplink channel. This helps in ignoring the request for the item which is already broadcasted from the queue. 3) In order to increase the bandwidth for pull channel remove the data items from slowest disk to broadcast schedule. The performance degrades as the pull channel will not have enough bandwidth which could result in high latency.

Another adaptive broadcast scheme was discussed in [17], which assumes fixed channel allocation for data broadcast and point-to-point communication. The idea behind adaptive broadcast is to maximize (but not overload) the use of available point-to-point channels so that a better overall system performance can be achieved. The authors of [25] have proposed a new framework for hybrid scheduling in asymmetric wireless environments. The algorithm is designed initially for unit-length data items which use Packet Fair Scheduling for push and MRF for pull. The cut-off point used to divide the data items for push and pull queues to minimize the access delay. Next, the algorithm is extended to address the data items with variable lengths. Stretch is the metric used to handle heterogeneous data items to minimize the access time.

III. RESULT AND DISCUSSION

1. Cache Management

In order to reduce access time and make the data available an important issue relating to data broadcast is client data caching. Client data caching is a common technique for improving access latency and data availability. In the framework of a mobile wireless environment, this is much more desirable due to constraints such as limited bandwidth and frequent disconnections. However, frequent client disconnections and movements between different cells make the design of cache management strategies a challenge. The issues of cache consistency, cache replacement, and cache pre-fetching have been explored in [21,22].

2. Data Allocation over Multiple Broadcast Channels

In [24], the advantages of having multiple channel broadcasts are discussed. The advantages are fault tolerance, configurability and scalability.

By having access to multiple physical channels, fault tolerance is improved. For example, if a server broadcasting on a certain frequency crashes, its work must be migrated to another server. If this server is already broadcasting on another frequency, it can only accept the additional work if it has the ability to access multiple channels.

In [26], the authors have proposed hybrid scheduling method to broadcast data items over multiple channels. The data items are divided into round-robin fashion over all the channels.

3. Clients Impatience

In real time scenario, clients lose their patience, when they wait for the required data item. Thus resulting in: (1) the client after waiting for certain time may leave the system because of impatience. This is called as reneging. Extreme impatience may result in dislike and might not join the system, which is known as balking. The performance of the system results in the behavior of the clients. (2) The client may send multiple requests for the required data item. If these multiple requests are from single client then there will be increase in the access probabilities of that item and as server is ignorant of this may broadcast it, thereby making an ambiguous situation. The solution for this problem is addressed in [9,10] thereby minimizing the number of dropped requests.

4. Multiserver Broadcasting

This is an interesting aspect where till now very less research work is carried and that to only on mathematical background [19].

IV. CONCLUSION

We have presented with various scheduling algorithms and concepts of how to further proceed in the research for the readers. We have also given enough information about the advantages and disadvantages.

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