International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 6, Issue 7, July 2019

A Study of Various Data broadcast Model for Air Indexing on Wireless channel

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Abstract: *The smooth and proper flow of information is the backbone of any system either it is social, industrial, commercial or technical. More efficient the flow of information in the system, the more effective the system will be in itself. So Information Technologies have become crucial for survival as well as growth of every field of industry. Data dissemination through wireless technologies has become prime need of current era of Information Technology. There are various data dissemination techniques out of which broadcasting is of prime utility. So many researches are going on to optimize broadcasting techniques in different parts of the world. Plenty of broadcasting schemes have been proposed. Different broadcasting schemes gives different results depending upon indexing scheme used and the number of channels for broadcasting. Indexing is used to minimize the tuning and access time. This paper will emphasize on the broadcasting model quality parameters and a detailed comparative study based on the indexing schemes.*

Keywords: data broadcasting, hashing, index tree technique, signature technique, indexing model.

1. Introduction

With the progress of technology the quality and coverage of technology is increasing day by day. The devices are being portable, networks are being wireless, services are being client-oriented so approaching towards convenience with cost cutting. There are various aspects of technological improvements, as improvement in hardware design, efficient usage of battery power, more powerful processors and efficient software approach. But the best from technological improvements will come out when parallel thinking will be implemented on all of these aspects of technological improvements. And no doubt the network is the best connecting element for different components. So the improvement in network technologies is critical for getting optimal outcome as a whole from a computer based system.

Network is used as infrastructure to connect different components of Information Systems and to disseminate the information among destined systems or people. Network can be wired as well as wireless. Both network categories have their own merits and demerits. We have been witnessing rapid growth in wireless technologies for last few years. However wireless technology cannot be considered as complete replacement of wired networks. Reliability, efficiency, safety and security etc. are some constrained factors of wireless technologies due to which industrial implementations of wireless technologies are somewhat slower. But we can envisage fast growth of wireless implementation in industries in near future [1]. Wireless networks are prone to constrained and variable bandwidth, limited battery power, lack of efficient wireless enabled algorithms and security protocols. Besides it depending upon the usage category of information the data dissemination can be classified as Unicasting, multicasting and broadcasting. Unicasting is the ways to send data to a single user in the network. Multicasting is the way to send the data to a group of users in the network. Broadcasting is the way to send information to everyone in the network. Different dissemination techniques used in different network applications can be shown as in table 1:

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S. No.	Data Dissemination method	Applications
1	Unicasting	Mailing, online payment,
2	Multicasting	Videoconferencing, Usenet news, Computer configurations, group chat
3	Broadcasting	Radio advertising, flooding information to everyone, alarming signal, weather reports, breaking news.

Table 1: Data dissemination methods and their applications

Before broadcasting data should be scheduled. The index information, which is broadcasted on the air intermixed with data, is a kind of directory that is commonly represented as a set of <data ID, address> tuples. With the index information, mobile clients can be informed of the address (i.e., time) of their target data. In this way, they can access the data without scanning the full wireless data stream. Also, by replicating the index information, the overall access time performance can be improved. Indexing is used to save the energy of mobile node. Several indexing techniques for wireless data broadcast have been introduced to conserve battery power while maintaining short access latency.

2. Related work

Among all these techniques broadcasting is most widely used for data dissemination in network. Broadcasting is the most scalable, resource efficient and powerful technique for data dissemination [2]. As most of the network provides gives asymmetric bandwidth availability i.e. more bandwidth for downloading and less bandwidth for uploading. So using the available uploading bandwidth efficiently is crucial. Here also the broadcasting proves itself as the best among all available data dissemination methods. One special kind of broadcast is termed as on-demand broadcast which guarantees the delivery of desired data [3]. Data broadcasting can also be categorized as listen only and interactive broadcast [4]. Broadcast is the most effective method to disperse the information to every user. The main characteristics of broadcasting can be stated as [4, 5]:

1. Broadcasting is the most scalable technique of data dissemination.
2. Broadcasting can satisfy an outstanding number of requests for a data item simultaneously.
3. Broadcasting makes efficient use of large downlink capability of the network.
4. Unlike multicasting, broadcasting doesn't need special support from hardware.

There is plenty of broadcasting models available using various indexing schemes to make the broadcasting system more efficient in term of time used to send and get the information from sender to receiver in the network. The two main parameters used to check the time efficiency of an indexing system are tuning time and access time. Some of the Indexing techniques were studied in [9], [13], [15], [16] and [17].

In [6] if there is wireless computing environment, conservation of the mobile client is critical issue to be addressed. Indexing method was introduced to low access time, low tune-in time and produce high indexing efficiency. These indexing method shows that battery power consumption in mobile client, can reduce with some access time. The indexing techniques are: The Index Tree Technique, The Hashing Technique, The Signature Technique, and The Hybrid Index. Among them, Hybrid Index is the best choice for improving power efficiency under both scenarios of single and multi-attribute based queries [6].

The [7] paper describes some Energy Efficient Indexing on Air. This paper analyze index based scheme with special emphasis on minimizing the power consumption and also the time to access the data. There are two optimal algorithms which are optimal in dimensional: access optimal and tune optimal. Two methods for

organizing and accessing broadcast data: (1, m) indexing and distributed indexing. In (1, m) indexing index is broadcast m times in one file. In distributed indexing instead of replicating the entire path, replicate only a part of it.

The [8] paper tells about hybrid indexing techniques based on index trees and signatures for data disseminated on a broadcast channel. Hybrid indexing method combining strengths of the signature and the index tree techniques is proposed. This method has the advantages of both the index tree method and the signature method and has a better performance than the index tree method. A variant of the hybrid indexing method has been demonstrated to be the best choice for multiple attributes indexing organization in wireless broadcast environments. Finally on the basis of analysis we got know that the signature and the hybrid indexing techniques are the best choices for power conservative indexing of various data organization on wireless broadcast channels.

3. Broadcast and Indexing

If data is broadcast without any form of index, then the client will have to be tuned to the broadcast channel continuously until all the required record is found and then it is downloaded. On the average, the client has to be tuned to the channel for half the duration of the broadcast cycle. This is unacceptable, as the mobile devices is equipped with a limited energy resource i.e. battery and the client remains in the active mode for a long time, thereby consuming precious battery resource.

We would rather provide a selective tuning ability, enabling the client to come into the active mode only when data of interest is being broadcast by providing a index information of the data. Selective tuning will require that the server, in addition to broadcasting the data, also broadcast a index that indicates the point of time when particular records are broadcast and available on the broadcast channel. Clients will remain in the doze mode most of the time and tune in periodically to the broadcast channel. In data broadcasting, there will be competition between two parameters:

2.1 Access Time

The time elapsed from the moment a client wants a data to the time when required data is downloaded.

2.2 Tuning Time

Tuning time is the amount of time spent by a client listening to the channel.

This will determine the power consumed by the client to retrieve the require data. To listen to the broadcast channel, mobile devices must tune in active mode, so the tuning time is also the time mobile devices in active mode. In a broadcast program with no indexes, both the access time and the tuning time will be N/2 in average where N is the cycle time of this broadcast program.

4. Broadcasting models

So for an efficient and effective broadcasting model, all these parameters must be considered to get the best outcome as a whole. To minimize the tuning time indexing is the best approach because it gives prior information about expected broadcasting time of the desired data over the channel [8]. By getting this information a device can slip into doze mode. In doze mode various components of device becomes inactive to save power till the requested data is made available over the network for access. In non-indexed broadcasting access time is same as tuning time. This can be understood with the help of following diagram: Let in the broadcast cycle D_4 is the requested data. Then in non-indexed broadcasting tuning time will be same as access time. This can be better understood with Fig 5.

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ISSN 2394 – 3386
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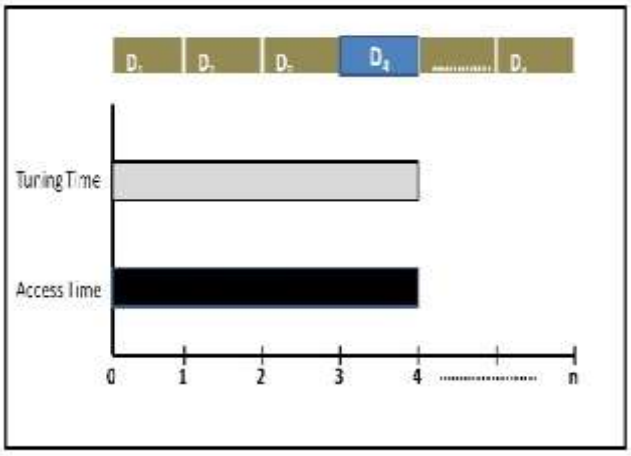

Fig: 5 Non-indexed data transmission details

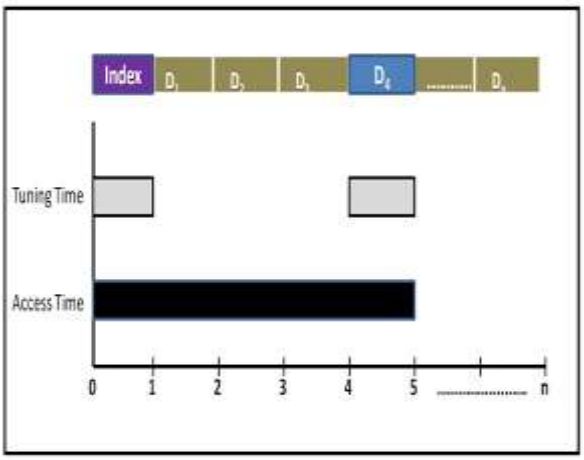

Fig: 6 Indexed data transmission details

But with the help of indexing tuning time can be considerably reduced which will lead to the power conservation [7]. But inclusion of index information in broadcasting information increases the length of broadcast cycle and so the access time. Considering the same broadcast cycle and same requested data item D_4 the tuning time and access times can be shown as in Fig 6.

It is clear from the diagram that improvement in tuning time is much greater than increase in overall access time. Besides this the size of index node is also 10-50 times smaller than that of a data node so increase in the length of broadcast cycle due to index information is negligible [9]. Still various approaches have been developed for minimization of access time for last few years. The access time depends upon the availability of bandwidth for downloading the requested data item. Higher the available bandwidth, lower the access time.

$$Access\ time\ \propto \left(\frac{1}{available\ bandwidth}\right)$$

On Indexed broadcasting scheme the waiting time can be classified in two categories: index wait and data wait. Where total Access time or waiting time can be given as [9, 14]:

$$Access\ time\ or\ Waiting\ time\ =\ (Index\ wait\ time\ +\ Data\ wait\ time)$$

- ***Index wait***: when a receiver tunes into the broadcast channel, the first bucket it gets may not be the index bucket. So the span of time for which the receiver will have to wait for index bucket is known as Index wait.
- ***Data wait***: After getting the expected arrival of desired data over the broadcast channel with the help of index information, the time for which the receiver slips into doze mode and waits for data is termed as data wait.

Another approach to minimize the access time is the use of multiple channels. In multiple channel approach a different number of channels can be allotted as index channel as well as data channel. Many approaches give single channel as index broadcast while allocating multiple channels for data broadcast [9]. Because Data wait time has more impact on access time than that of index wait time. So it considerably reduces the access time as a whole. Many other approaches use multiple channels for index broadcast as well as data broadcast. As we increase the number of channels, the access time will decrease. As access time can be described as

$$Access\ time\ in\ multiple\ channel\ =\ \left(\frac{Size\ of\ data\ to\ be\ broadcasting}{number\ of\ channels}\right)$$

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5. Performance Analysis of broadcasting models

Considering access frequencies in distributed indexing method minimizes the average access time as well [10]. Broadcast disk scheme proposed by S. Acharya et.al, segregates data in different disks according to their access pattern and sends data more often from the disk which has high demand data [11, 12]. Skewed or unbalanced indexing also minimized the average access time by giving less number of index search to the most accessed (hot) data on the cost of more index search for less desired data [3, 5].

Energy efficiency is always a quality parameter in wireless domain because small portable devices rely on tiny batteries for power. In the lack of power management policy, the broadcasting scheme is said to be inefficient. So better the data dissemination scheme, more the power conservation. Although broadcasting itself is the most energy efficient data dissemination method. And reducing tuning time saves battery power due to switching into doze mode until the requested data is broadcasted over the network. Energy saving can also be performed with the help of selective tuning [4].

6. Result

The multi-parametric comparison of variety of available broadcast models and indexing model is shown in table 2:

S. No.	Technique	Tuning time	Access time	Access probability	Indexing model	No. of Channels	Error resilience
1	Hashing scheme for multichannel broadcast	yes	yes	yes	Hash function	Multiple channels	Considered
2	Index and Data Allocation on Multiple Broadcast Channels	no	yes	yes	Extended distributed indexing	Multiple channels	Not considered
3	SAMBox	yes	yes	no	Index tree	Multiple channels	Considered
4	Broadcast disks	no	yes	yes	Skewed indexing	Single channel	Not considered

Table 2: Comparison of broadcasting models

7. Conclusion

In this paper, we have described multiple parameters of the broadcasting models and their impact on the performance of the broadcasting scheme. Although main concerns of broadcasting techniques is to reduce tuning time to conserve the battery power of portable wireless devices. The advent, need, concerns, quality affecting parameters, benefits etc. of broadcasting have been described in this paper. We have given a combined comparative analysis of many broadcasting schemes based on the indexing models used and other parameters with the help of single table. It proves to be beneficial for all round study of multiple broadcasting schemes and we have also discussed and analyzed energy efficient air indexing techniques.

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