An Efficient Architecture for Query Processing in Mobile Environment

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Summary
The downstream communication ability from servers to clients is much better than the upstream communication ability from clients back to servers, in various existing and rising application domains. For query processing in mobile environment, a well-organized architecture is proposed in this paper. Utmost of downstream communication capacity of server is exploited by the proposed architecture to offer the client with the desirable information through least requirement for Data pull. This is for the reason that Pull-based systems are a poor match for asymmetric communications environments, as they need considerable upstream communications capabilities. The mobile clients are allowed to maintain a service execution neighboring to their location perspective and to thematically find the mobile, by the proposed method. For managing host mobility, an adaptive updating algorithm is too offered. The lessening of the client power utilization and raise in query efficiency are revealed by our architecture using extensive simulation results.

Keywords:
Broadcast, Query, Mobile host, Mobility, Location.

1 Introduction

The improvement of ubiquitously-accessed networks is one of the most imperative and smart research topics in computer networks at this time. At this juncture computer resources could be accessed by the users at anytime from anyplace through movable computers. To assist mobile communications in existing network environments, a significant quantity of research has previously been performed. The understanding of low cost location management of mobile hosts has been directed by these methods. The mobile computing environments presently under growth must determine numerous data management issues for instance query processing, other than the packet transmission needed in conventional mobile communication protocols [1].

Throughout their life, Nodes (clients and servers) possibly will not stay connected to the MANET. A node must be capable to hear the transmission of at least a single node from network and should have adequate functional power, to be connected to the network. There are three modes of operation for a node, which are designed to reduce the power.

These are the transmit modes, receiving modes and standby modes. Transmit mode permits transmission and reception of messages and moreover this employs the majority power. The processing of data and reception of transmissions are permitted by the receiving mode. Processing, transmitting or receiving are not done by CPU in this standby mode.

The downstream communication ability from servers to clients is much better than the upstream communication ability from clients back to servers, in various existing and rising application domains.

The consumers can consume the similar web services despite of the place, time and device owing to the appearance of latest lightweight web technologies and the growth of mobile devices. Networking capabilities and sensors have been outfitted by the mobile devices to give flexible context and user-community information. To compensate the restricted means of input, this information improves the user experience.

Numerous applications have turned into progressively more fashionable in current days in a mobile computing environment for instance stock activities, traffic reports and weather forecast [14]. Small batteries are used by the mobile computers for their processes, without involving any power resource. The bandwidth of wireless communication is in common restricted. Accordingly, to preserve the energy and communication bandwidth of a mobile unit, an imperative Service Oriented Architecture SOA in a mobile system is subjected at the same time as permitting mobile users of the capability to access information from everywhere at anytime [16], [17].

We consider Location sensitive queries, among queries in a mobile computing environment. They are used (1) to acquire the location of a mobile host, (2) to find out the existence of a mobile host, and (3) to gain data accumulated in a mobile host (e.g., location dependent information such as the sensor value set on a mobile host). Although the major responsibilities for both are the execution of location information of each mobile host, the tactics for processing such queries are considered to be quite unlike from those employed for mobile communication protocols.

The paper is organized as follows. Section 2 presents the related work. In Section3, we study mobile communication protocols to process location sensitive

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queries. Section 4 presents the model for query processing. In Section 5, we describe our proposed architecture. Simulation results are presented in Section 6 and the conclusion is given in section 7.

2. Related Work

PCIKNN, a novel itinerary-based KNN query processing technique is proposed by Tao-Young Fu et al. [6]. Dissimilar routes are resulting from this technique intending at optimizing two performance measures, response latency and energy consumption.

The problem of handing out constant range queries over mobile objects is addressed by Dragan Stojanovic et al. [7]. A spatial network restrains his motion. The user-selected area, the map window, the polygonal feature or the area précised by the distance from an orientation point of interest is symbolized by the query range. Contrary to the one time assessed usual queries, constant query residues energetic over a period of time. To afford efficient processing of constant queries with reverence of CPU time, I/O time and main memory utilization is the foremost challenge for this problem.

Two new algorithms for dealing out k nearest neighbor queries and vary queries on spatial networks with confidentiality safety are recommended by Wei-Shinn Ku et al. [8]. To screen the accurate mobile user location with a masked region is the chief thought of this method. The query requester is sheltered by the masked region and at least K − 1 other users based on the K-anonymity concept. According to both the masked region and the fundamental networks, the spatial queries are performed.

The WSN method was proposed by Giuseppe Amato et al. [9]. This approach can be planned by means of a query language (MW-SQL). This query language offers builds particular for sensor networks. A JDBC driver put in a nutshell within the OSGi framework provides the query language.

The major confronts controlling today's database improvement regarding the processing environmental data. sensor data and sensor networks, stream processing, approaching uncertain and imprecise data, data mining, and wireless broadcast and mobile computing have been proposed by Jaroslav Pokorný et al. [10]. The required innovative DBMS architectures and their personalities are briefly explained in the conclusions.

The appropriation of utilizing service-orientation computing paradigm in mobile and wireless environments has been explained by Mohamed Hamdy et al. [11]. By functionality allocation via service-orientation, the overcome restrictions of mobile devices are described in this method. In order to become veracity, a few key regions to be addressed have been recognized for this vision. To confer the misplaced areas, the presented approaches have been examined in these areas.

An efficient protocol between the client and database was described by Mikhail J. Atallah et al. [12]. This description is done through learning the answer to a client's location-dependent query without enlightening to the remote database anything concerning his location, except the database can conclude from the answer it gives to the query.

Three asymmetric features of a mobile environment have been discovered by Wen-Chih Peng et al. [14]. Subsequently, query processing methods for both join and query processing are invented by us in light of these aspects. Explicitly, three unlike join methods are inspected consistent with those asymmetric characteristics of a mobile computing system and to discover MI/SI profitable semi joins some definite measures have devised.

To architect and employ a constantly adaptive query engine appropriate for global-area systems, massive parallelism, and sensor networks have been afforded by J. M. Hellerstein et al. [19]. A survey of preceding work on adaptive query processing is offered to set the stage for our research, focusing on three characterizations of adaptivity: the regularity of adaptivity, the possessions of adaptivity, and the degree of adaptivity.

A common view of location relatedness in the queries has been proposed by A. Y. Seydim et al. [20]. Location consciousness and location reliance are renowned between them by us. They provide a formalization of the approach.

Latest confronts presented by this state to the distributed database framework are illustrated by F. Perich et al. [21], furthermore the design of a framework is presented for serendipitous querying and query reaction in an ad-hoc mobile environment.

A query processing mechanism called an eddy has been recommended R. Avnur et al. [22]. As it runs, this mechanism constantly reorganizes operators in a query plan. It characterize the moments of symmetry is characterized by this technique during pipelined joins can be easily rearranged, and the harmonization fences that need contributions from dissimilar sources to be synchronized. The optimization and execution phases of query processing are combined; permitting each tuple to have a stretchy organizing of the query operators by combining eddies with suitable join algorithms.

3. Techniques Used in Mobile Communication Protocols

To practice location perceptive queries in Section 4, mobile communication protocols in view to their capability has studied in this section. The model illustrated in Figure 1 is used as an example. A mobile host is a competent system of moving across wireless cells. A router is a system that promotes packets from/to mobile hosts. A router administers a wireless cell and the packets could be switched with any mobile host located in its cell by the router. Mobile communication protocols are concerned with properly and competently shifting packets to the target mobile host.

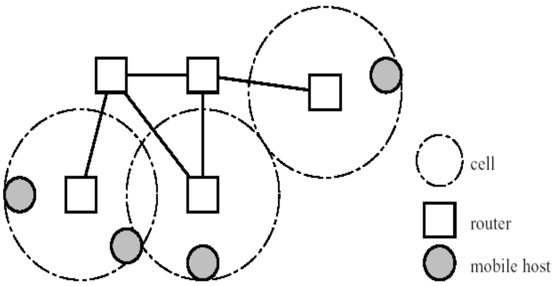

Fig. 1 An example of a communication network.

Broadcast Notification (BN): A mobile host's location information is broadcast throughout the network on each migration. According to this information, data packets for the mobile host are forwarded to the current location.

Default Forwarding (DF): A default router exists for each mobile host. The default router maintains that host's location information. A local router is located in the same network as the mobile host and notifies the default router of the mobile host's current location. Data packets to the mobile host are first forwarded to the default router and then forwarded to the local router.

Broadcast Query (BQ): On receiving a data packet addressed to a mobile host, the router broadcasts a query packet to all the other routers in order to forward the data packet according to the reply.

In addition to the above three strategies, the following two strategies can be used to support mobile hosts:

Default Query (DQ): Like DF above, there exists a default router for each mobile host. The default router is informed of the mobile host's current location. On receiving a data packet addressed to a mobile host, the router asks the default router for the location of the mobile host, and then forwards the data packet to the location identified in the reply.

Broadcast Forwarding (BF): This strategy is based on a broadcast mechanism. The router receives data packets and then broadcasts them to the entire network. This strategy has been widely used in packet radio networks.

4. Query Processing for Location Sensitive Queries

4.1 Model

A mobile host, which can travel across cells, can maintain pieces of information, which may be obtained by other systems. The queries about mobile hosts are invoked by a system, called client. In accordance with the requests from clients, a query server (QS) is a system, which handles mobile query processing. Through a global network, every client is directly or indirectly associated to at least one query server. Through its wireless interface, A mobile host server, can directly be in touch with all mobile hosts in the similar cell, moreover can communicate with all query servers through global networks too. A paradigm of a network that comprises clients, query servers, mobile host servers, and mobile hosts are exposed in figure 2.

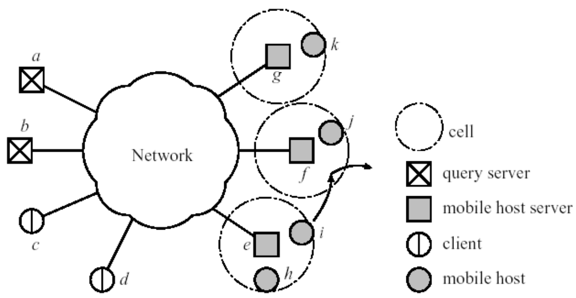

Fig. 2 An example of mobile database network.

The following types of location sensitive queries are considered for mobile hosts.

1. Location (L) query: A query to obtain the location of a mobile host. Note that an L query is not concerned with whether the mobile host is active or not.

2. Data (D) query: A query to obtain a piece of information from a mobile host.

Now, we propose architecture for handling the three types of queries.

5. Proposed Query Processing Architecture

We design an architecture which uses the following strategies (i) Server push (SP) and (ii) Client Pull (CP).

The downstream communication ability from servers to clients is much better than the upstream communication ability from clients back to servers, in various existing and rising application domains.

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). Pull-based systems are a poor match for asymmetric communications environments, as they require substantial upstream communications capabilities.

Utmost downstream communication is used by our proposed architecture for effective query processing.

5.1 Server Push (SP)

The server push stage occurs before clients pull (CP) so that the maximum number of potential data needs can be served at the lowest power cost. When the data needs of a client are satisfied by the broadcast, the need for data query is reduced.

For Handling (L) query: SP is limited to the transmission of information by servers. Servers transmit the unique ID and location of their mobile hosts to the QS. Each QS broadcasts this information to its clients so that the clients can use this information to choose the nearest server to query during the data query process. All mobile host 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.

For Handling (D) query: The data broadcast by the servers consist of pre-selected and dynamic set of data items from the mobile hosts. The preselected items are determined at the deployment stage by the network designer based on the frequent requirement of the clients. The preselected data items are the same for each host. The dynamic portion of the data broadcast will vary, depending on the unserved data queries from the previous service cycle [4].

If a client detects no servers it will be in standby. Clients know the details of the servers in their region from the transmitted information of (L) query. The client will listen the static content once and it will check the index for any needed dynamic data items. It will use the index to determine when the data item will be transmitted. To listen to these items, the client must be in receiving mode.

In addition to that, the server nodes must restructure their broadcast schedule based on the client access patterns received from the other QS. This helps is to provide relevant information to the client nodes. To solve this issue, we have proposed an efficient adaptive query processing algorithm.

5.1.1 Adaptive Updating Algorithm

Because of its movement, the mobile host must synchronize to the other hosts with the AP and the host's AP has to be modified. In this section, we present an adaptive updating algorithm, which address the issue of satisfying the clients in the immediate vicinity of the host when the host moves to a new cell.

Assumptions

AP	→	Client's Access Pattern
MH_i	→	Mobile Host
$C1_{MHi}$	→	Current cell of MH_i
$S1_{MHi}$	→	Server of MH_i in $C1$ MH_i
$C2_{MHi}$	→	New location of moved MH_i
$S2_{MHi}$	→	Server of MH_i in $C2_{MHi}$
C_s	→	The count of hosts which are in the immediate vicinity of the host MH_i.
C_{oc}	→	The count of old clients in server MH_i.
C_{nc}	→	The count of new clients in server MH_i
MH_j	→	The host which is present in the immediate vicinity of host MH_i
$SCMH_j$	→	Score returned by MH_j
$APMH_j$	→	Access Pattern returned by MH_j
$APMH_i$ i	→	Access Pattern returned by MH_i

If MH_i moves from $C1_{MHi}$ to $C2_{MHi}$, then

(i) $S2_{MHi}$ notifies all QS of the existence of MH_i in $C2_{MHi}$.

(ii) $S1_{MHi}$ notifies all QS that MH_i is no longer in $C1_{MHi}$

The server MH_i broadcast its unique ID, AP and new client's information to all. MH_i. Each MH_j calculates the score of participating clients against the new clients from MH_i. Then it returns the score and AP of new clients back to MH_i. The AP of the host MH_i is modified from the response received from all MH_i as follows.

$$APTMH_i[n] = \sum_{K=0}^{Cs} APMH_j[MH_{jk}] * SCMH_j[SCMH_{jk}] / SP_c$$

Where $n = 1$ to Np.

SP_c → Count of which contain the $APMH_j$. The MH_j which does not contain the AP is not added in the calculation.

$$APMH_i[m] = AP_{oc}[m] * SCS_{oc}[m] + APTMH_i[m] / 2$$

AP_{oc} is the access pattern of the clients who are still participating with. $MH_i C_{oc}$. SCS_{oc} is the Score of AP_{OC}. The process is applicable for all the number of servers (m).

N_P → Pattern Length

5.2 Client Pull (CP)

In CP, every client transmits its unique ID and location to other nodes. When the transmission channel is apparent, clients transmit their information. To carry out routing of peer-to-peer messages during the data pull phase, the location of each client is required.

For Handling (L) query
From the SP stage, the clients came to know the location information of the hosts. Also it can send a L query to the QS to get the specific location of a host. Each QS can directly reply to every L query

Handling (D) query
In D query, clients request data from servers by sending a request to the QS. The QS cannot directly answer. Therefore it must send a packet to the mobile host server according to the information it holds. Servers respond to data requests from clients and perform any requested peer message routing. The servers have two primary tasks during the CP stage. First they must respond to data queries. Second, servers must route client peer communications when requested. The client may need to make a data request or to communicate directly with another client. Using the information collected from the most recent CP stage, the client will detect the target client and transmit the data. If it cannot detect the target client, a routing request will be sent to a server. Through the server, finally it may receive a peer message.

6. Experimental Results

This section deals with the experimental performance evaluation of our algorithms through simulations. In order to test our protocol, The NS2 simulation software [17] 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.

6.1 Simulation Parameters

Average Power Consumption The average power consumed by clients and the average power consumed by servers are calculated.

Broadcast Effectiveness The broadcast portion of mobiles is important, as server push is energy efficient. It is the ratio of items of interest in a broadcast to the total number of items transmitted.

Query Efficiency The data pull section will rely on the measurement of query efficiency. This is a measure of the percentage of data queries that get served during an entire simulation.

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

6.2 Simulation Results

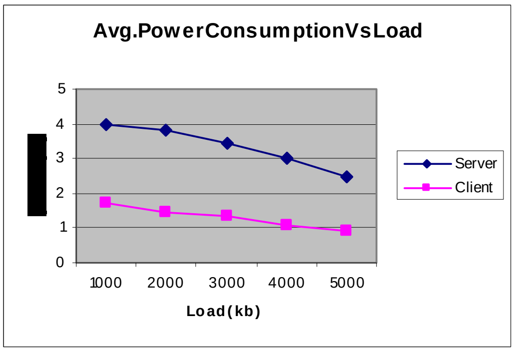

Fig.3 Avg.PowerConsumption Vs Load

In Fig3, when the broadcast size or server load increases, the average power consumption for server decreases as less time is spent for transmitting. The average power consumption for clients is universally low, because of the high level of disconnection due to the nodes movement.

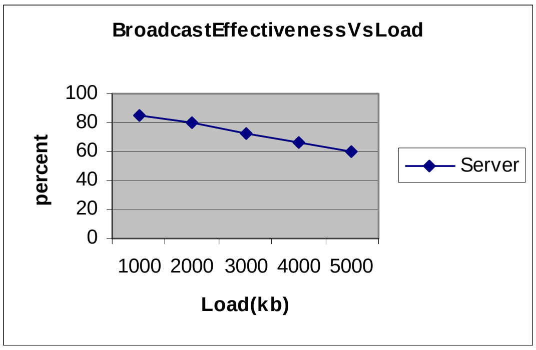

Fig.4 Broadcast Effectiveness Vs Load

Figure 4 gives the result of broadcast effectiveness. The broadcast effectiveness decreases as the server load increases, because the ability of a server to handle all data queries and peer message routing requests decreases.

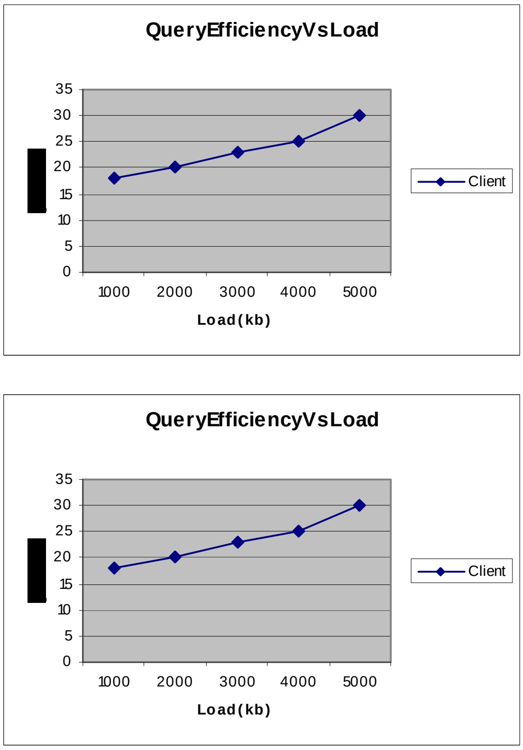

Fig.5 Query Efficiency Vs Load

From Fig.5, we observe that the query efficiency increases when the broadcast size increases.

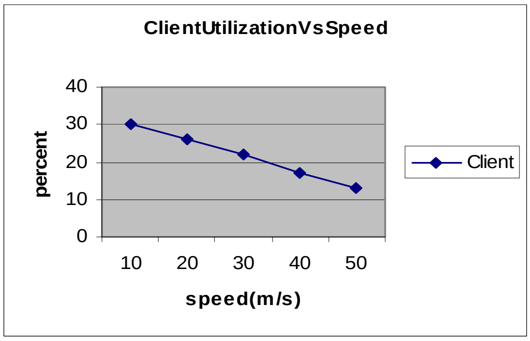

Fig.6 Client Utilization Vs Speed

In Fig.6, the client utilization decreases significantly when the host mobility is increased.

7. Conclusion

A competent architecture is recommended in this paper for query processing in mobile environment. To offer the client with the required information, utmost of downstream communication capacity of server are utilized by our proposed architecture with least necessitate for Data pull. As they need considerable upstream communications abilities, Pull-based systems are a pitiable match for asymmetric communications environments. An Adaptive Updating Algorithm has been presented subsequently for managing host mobility. Lessening of the client power utilization and rising in the query competence are revealed through extensive simulations by our proposed architecture.

An interesting future work is to reduce the load and message processing cost of the servers.

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