An Efficient Way to Track Peers in Mobile P2P Network

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ABSTRACT
In this paper, we propose a new class of message routing scheme for a distributed network which can scale up to the needs of a very large number of mobile users. We leverage the work in the GeoKad paper which uses the Distributed Geographic Table, allowing node retrieval from resources that are close to any given region. The paper addresses the problem regarding efficient message passing and peer misses. We propose a new routing scheme that addresses this kind of limitation. In fact, the problem can be solved in two ways, either by preserving the state of peer and further use a prediction algorithm or by better message routing. The proposed scheme is based on swarm intelligence (SI) and its attribute of exploit and explore. We leverage the statistical properties of time-varying network connectivity for opportunistic message forwarding. Considering the present 3G or Wi-Fi environment this approach can also help in optimizing energy as it can prevent query over flooding which is mostly encountered in such network scenarios.

Categories and Subject Descriptors
C.2.1 [**Computer-Communication Networks**]: Network Architecture and Design – Distributed networks; C.4 [**Performance of Systems**]: Performance attributes

General Terms
Performance, Design, Theory.

Keywords
P2P, Mobile Computing, Swarm Intelligence.

1. INTRODUCTION
Location-based search in P2P networks usually re-use existing protocols to provide good discovery results [5]. In recent years tracking and localization devices have become of widespread use and are increasingly applied both to industrial and social services. Moreover, ubiquitous and pervasive space has seen a large opportunity in sharing resources and contexts due to increase in the number of mobile devices [8]; as a result, discovering potential users under a heterogeneous environment generally becomes challenging. The situation becomes more severe when there are multitude platform devices and dynamic resources. Additionally, the mobile situation is still based on low range personal area network (PAN), therefore, it's always difficult for a peer to know there proximate peer, which happens to be sporadic. Considering an example of a large mall where hundred thousand customers visit every day. People show different and diverse moving patterns. In such a case, to figure out a potential proximate peer for sharing any kind of resource (e.g. sharing advertising information for a restaurant with a certain group that feels hungry after hanging around for a while) requires understanding the customer mobility. In such situations, to figure out the *optimal* is always cumbersome. Collective intelligence in form of swarm intelligence [7] provides a platform to mitigate such problems inherently.

In this paper, we figured out an efficient way to track reasonable peers in intermittent P2P networks in case of mobile devices. Our approach will solve the problem when there is an increase in the number of peers (inability to pass global knowledge in a given time period result into peer misses). In addition to connectivity, in general it is not guaranteed that two mobile nodes will ever meet each other. Therefore, even if infinite delay is allowed some nodes may never be able to deliver messages, especially in the case of fewer nodes. Applications can sometimes obtain network information dynamically or measure link performance with respect to particular peers, but even when this is an option, it takes time. The application cannot always start out with an optimal arrangement of peers, thus risking at least temporary poor performance and excessive cross-domain traffic. Providing more information in peer selection can improve P2P performance and lower ISP costs.

The mobile P2P network needs to address the following issues. First, the system should provide a network aware discovery scheme for mobile hosts to find new resource providing peers that share files in their currently resident wireless network. Second, the system should provide a *resource discovery* control policy for mobile hosts to obtain fresh status of peers, i.e., *peer's join and leave*, in a mobile network. The approach which we are considering solves the above two problems, better peer updation (message passing time) as well as reduced peer misses. The main objective of our work is to enable continuous resource discovery and better peer management for mobile users in mobile networks.

2. RELATED WORKS
So far, location-based searching in P2P networks is mainly approached by re-using existing structured overlays that are used to provide efficient one dimensional lookups. Related works [1]

MobiCom'12, August 22–26, 2012, Istanbul, Turkey.
ACM 978-1-4503-1159-5/12/08.

[6] have shown methodologies on tracking peers in mobile environment. The Geokad [1] uses the technique of geographic based table to update the peer information in such a dynamic environment. The problems they faced were peer misses and inefficient message passing due to the poor peer updating (message passing time) latency. Mobile P2P networks are typically used for connecting nodes via largely ad-hoc connections. In this paper, we have used the concept of swarm intelligence (an AntNet [4] concept) to propose a distributed P2P service. We believe that the swarm intelligence is one way we can counter the problem of efficient message passing (countering latency).

3. THE MODEL

This section gives an overview of the proposed system. We exploit the situation described in the paper and apply a state preserving look up concept. We use the concept of super node (which behaves as a server node). To reduce the overhead the routing state will be preserved as in position and velocity. Since any node can behave as a super node, accounting its stability we assume some time period. The whole idea is to provide a better interconnection between the super peer P_i and all other neighboring peers $P_u$where $u \in (1, \dots. n)$. Not to forget, the DGT information will be stored in a table τ of size C$\times$ n, where *C* is the size of controlled vocabulary for distance and *n* is the number of peers moving with a velocity *v* (each peer maintain this table). The information is based on the latency recorded from different peers. We assume that at start up, all table entries are initialized with the same small value τ_{init}. Our approach is different from the the existing GeoKad approach as the later uses an iterative based concept while we incorporate a query based concept.

In this model we consider a TTL (time to live) parameter T_{max} to prevent infinite query passing. If a query is received by a peer P_i that stores documents satisfying through query, it creates a backward response. Hence the total time period for querying peers will be 2$\times$ T_{max}. Our routing strategy is based upon the Adaptive transition rule [3] which consists of two strategies which actually complement each other. Based on probability w_s each query A^Q decides if it applies the *exploiting* or the *exploring* strategy. In exploiting strategy the link to the best neighbor peer P_j with the highest quality is selected by applying the following equation:

$$j = argmax_{u \in U \wedge u \notin S(A^Q)}[\tau_{cu}] \qquad (1)$$

Where *U* is the set of neighbor peers of P_i, and S $[A^Q]$ is the set of peer already visited by A^Q.

The exploring strategy encourages the query to discover further new paths. In case A^Q utilizes the exploring strategy, the transition rule shown in (2) and (3) is applied for each neighbor peer P_j. The first step is to derive a *good-ness value* p_j for each neighbor peer P_j not already visited. In the second step adapted version of *roulette wheel selection* is applied for selecting peers [3]. This strategy allows to more than one peer to be selected to account for the fact there are multiple possible destination peers which contains answers for the query. To ensure that at least one peer is selected the model boils to the exploiting based strategy in case of exploring strategy does not select any peer.

$$p_j = \frac{\tau_{cj}}{\sum_{u \in U \wedge u \notin S(A^Q)} \tau_{cu}} \qquad (2)$$

$$GOTO_j = \begin{cases} 1, & if\ q \leq p_j \wedge j \in U \wedge j \notin S(A^Q) \\ 0, & else \end{cases} \qquad (3)$$

Where q is a random value, $q \in [0,1]$, and $\sum p_j = 1$. In case of $GOTO_j = \ 1$, A^Q sends a clone of it to peer P_j.

If an query arrives at a certain peer P^Dstoring appropriate storage documents D, it generates an response and supplies with D and with a copy of stack that contains all visited peers S (A^Q). The response calculates the sum of all entries in S (A^Q) to get the total number of hops T_D for the path from the querying peer P^Q. The strength of the path depends upon the goodness of the path. The goodness of the path is found by the comparing the number of documents found and the length of the path to optimal values. As shown in the below equation, parameter w_d weights the influence of document quantities and path lengths.

$$\tau_{cj} \leftarrow \tau_{cj} + Z, \qquad (4)$$

$$\text{Where} \quad Z = w_d.\frac{|D|}{D_{opt}} + (1 - w_d).\frac{T_{max}}{2.T_D} \qquad (5)$$

Then strength of the path is governed by the function:

$$\tau_{cu} \leftarrow (1 - \rho)\tau_{cu} \qquad (6)$$

$$\text{Where } \rho \in (0,1]$$

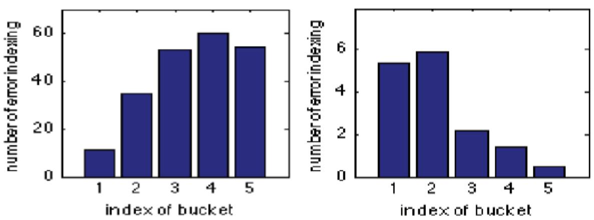
System consists of two distinctive components one is the super node which is chosen as the most stable node and the other comprise of all flash mobile nodes, we call them clients. Our system specifies the query-response message exchange between a client and a super peer. Since we are leveraging Swarm Intelligence mobility of peers is guaranteed. The client would query the other client's information about candidate peers from the super peer. Then the client could connect to one peer or set of peers (remember that we based our concept on exploit and explore) is chosen by client based on the information, and then client exchange some data with choosing peer without any action of super node as P2P system. Generally this kind of system assumes a super node for a certain time period based upon the strength of the edges which can be referred as the amount of pheromone if we take AntNet [4] as an example.

The *super node* (considered to be a stable node, for a given time interval) has responsibility to manage the overall network topology; a probabilistic overlay network – that indicates the most promising path and can consequently create ratings for any combinations of resource provider and resource consumer location. Each super node makes a list called *bucket list* (derived from the GeoKad paper) connected to client peers. Bucket list is constructed based on network latency. Each super node peer can be the center of k different concentric circles, each having a different radius and corresponding to a list that contains the client peers.

The *client* is kind of mobile peer and knows where the super node from the query passing concept (exploring one). When client enters the network, client peer should sequentially invocate to super node which is close to get all candidate's data that is in proximity. In nutshell, we don't need to make a whole *look up* structure which generally is done in case of GeoKad as well as we provide efficient query based approach which will prevent over flooding of queries and hence provide energy efficiency in building such a system.

4. IMPLEMENTATION AND COMPARISON

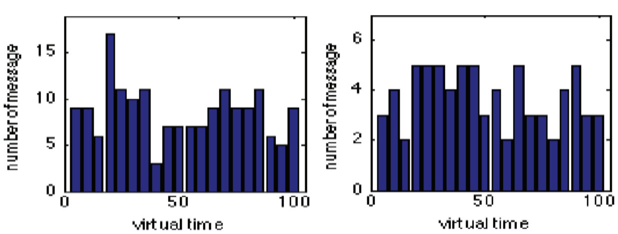
We designed our own simulation environment for implementing our proposed system using Matlab. We considered a test condition which can support both inner and outer ambiance. Our test condition include the fact that the peer join also depends upon latency, we also added an extra attribute to the existing concept so that same peer in the same distance range can also consider latency Figure 1 shows the bucket error index comparison. As compared to GeoKad like system (figure 1(a)) we achieved reduction in the number of missing nodes. This metric is important to evaluate accuracy of system.



(a) Geokad (b) From our Model

Figure 1. Bucket Error Index.

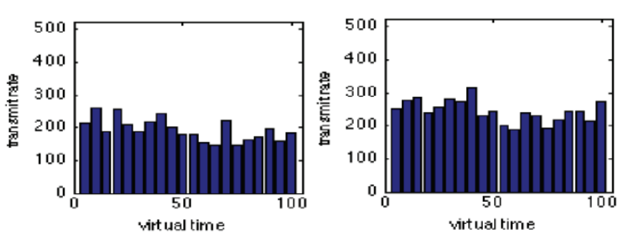
The average message rate is the number of initialization message required to join the system from new peer. Figure 2 shows the result of the number of initialization messages. From the figure, GeoKad like system should obtain geographic information on from all nodes in the initialization, so the number of messages is higher than our proposed methodology which is requested by peer to get candidate peers.



(a) GeoKad (b) From Our Method

Figure 2. Message Rate.

Figure 3 shows the data transmission rate that our methodology can determine which has higher rate than the original system.



(a) Geokad (b) From our Model

Figure 3. Data Transmission Rate.

5. CONCLUSION AND FUTURE WORK

We leveraged GeoKad and proposed a new way to route messages in this kind of system to achieve better message passing, which further could lead to less peer misses. We didn't take into consideration about the intermittency due to latency in this work (as the original GeoKad doesn't take it into consideration, in fact, to our knowledge this is first of its kind research to introduce latency resulting to intermittency) and planning to adopt it using *eta-strategy* [2] in case of vehicular peer to peer network using the present GeoKad protocol. Our system specifies the query-response message exchange between *a client* and *a super peer.* The *super peer* stores a list of connected *client* peers to manage this overall network topology. This allows us to find available peers that have higher network latency. Through computer simulation, we have evaluated the performance of our proposed location-awareness mobile system and leveraged GeoKad kind of service. Simulation results have shown that our proposed system achieves lower bucket error index and message rate with higher data transmission range than GeoKad type system.

6. ACKNOWLEDGEMENT

This Research was supported by the KCC (Korea Communications Commission), Korea, under the R&D program supervised by the KCA (Korea Communication Agency) (KCA-2012-11911-05005).

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