Abstract

In a Mobile ad hoc Peer-to-Peer (M-P2P) network, mobile peers (MPs) interact with each other in a peer-to-peer (P2P) fashion. Proliferation of mobile devices (e.g., laptops, PDAs, mobile phones) coupled with the ever-increasing popularity of the P2P paradigm (e.g., KaZaa, Gnutella) strongly motivate M-P2P network applications. However, challenges such as free-riding, data accessibility and mobile resource constraints (e.g., energy) need to be addressed for realizing M-P2P applications. In particular, economic incentive schemes become a necessity to entice mobile peers to share their data, given the generally limited resources of mobile devices. Furthermore, in M-P2P networks, data availability is typically low due to rampant free-riding, frequent network partitioning and mobile resource constraints. Hence, this dissertation focuses proposes economic incentive-based approaches for effective data management in M-P2P networks.

In this regard, this dissertation makes the following key research contributions. First, we propose the economic incentive-based top-$k$ query processing system in M-P2P networks. The system assigns rewards/penalties (payoffs) to MPs for incentivizing their participation and for enabling them to re-evaluate their data item scores for top-$k$ query processing. Furthermore, we extend the system to incorporate the notion of a peer group-based economic incentive scheme. Second, we propose the system for improving data availability in M-P2P networks by incentivizing broker MPs to provide value-added routing service, which includes pro-active search for the query results
by maintaining an index of the data items (and replicas) stored at other MP's (as opposed to just forwarding queries). Moreover, the system also incentivizes relay peers to act as information brokers for improving data availability and efficient load sharing. Third, we propose the system for efficiently managing the vehicular traffic in road networks using economy-based reward/penalty framework with traffic congestion control. In particular, a user is rewarded for following system-assigned paths, while it is penalized for any deviations from the system-assigned paths. Finally, we present an economic incentive system for improving rare data availability by means of licensing (with group-based) replication in M-P2P networks.

Our performance evaluation demonstrates significant improvements in the processing of top-k queries in terms of query response times and accuracy at reasonable communication traffic cost, as compared to existing schemes. We also determine the number of brokers, beyond which the mobile peers are better off without a broker-based architecture i.e., they can directly access data from the data-providing peers. Furthermore, our performance study for E-VeT shows that it is indeed effective in managing vehicular traffic in road networks by reducing the average time of arrival and fuel consumption. Finally, our performance study indicates considerable improvements in query response times and availability of rare data items in M-P2P networks.

**Keywords:** Mobile-P2P networks, mobile computing, data management, data replication, top-k query processing, economic schemes and incentives

We are pleased to note that the contributions of this dissertation work have been published at following reputed conferences and journals.


Moreover, the following papers are currently under review in journals.

• Nilesh Padhariya, Anirban Mondal, Sanjay Kumar Madria and Masaru Kitsuregawa. “Economic Incentive Schemes for Improving Availability of Rare Data in Mobile-P2P Networks”

• Nilesh Padhariya, Anirban Mondal and Sanjay Kumar Madria. “Top-k Query Processing in Mobile-P2P Networks using Economic Incentive Schemes”