Chapter 1.30
Database Queries in Mobile Environments

N. Marsit
IRIT—Paul Sabatier University, France

A. Hameurlain
IRIT—Paul Sabatier University, France

Z. Mammeri
IRIT—Paul Sabatier University, France

F. Morvan
IRIT—Paul Sabatier University, France

ABSTRACT

The technological evolution of networks together with the development of positioning systems has contributed to the emergence of numerous location-based services. Services related to this expanding area will become of major technical as well as economical interest in the coming few years. This aroused a great deal of interest from the scientific community at large and specifically from those studying these services and their diverse requirements and constraints. One of the direct consequences in the database field is the appearance of new types of queries (mobile queries issued from mobile terminals and/or requesting information associated with moving objects such as vehicles). Our objective in this chapter is to present a comprehensive survey of the field of research work related to mobile queries, with particular attention to the location issue.

INTRODUCTION

Mobile units are obviously on the rise. Thanks to the technological progress realized in this domain, mobile terminals and units have become successful and widely used by the general public. At the beginning of the wireless revolution, the main objective of wireless networks was to enable mo-

bile units to communicate. Nowadays, networks support various new services and applications. In fact, the significant technological evolutions added to the development of positioning systems such as GPSs have contributed to the emergence of a large number of location-based services and applications (e.g., a mobile user asking for data related to his location such as the closest hotel). These types of applications are about to become the major focus of economical interest in the next few years. The location-based service benefits are expected to exceed $40 billion in 2006, while they were estimated to approximately $1 billion in 2000 (Mokhtar & Su, 2004). This has aroused the interest of a great part of the scientific community devoted to research and development in this area. One of the direct consequences in the database field is the appearance of new types of queries. In mobile environments, there are two basic categories of queries (Marsit, Hameurlain, Mammeri, & Morvan, 2005). The first one includes queries issued from mobile terminals and querying data related to fixed objects (such as hotels, gas stations, hospitals)—for example, "select the closest restaurants." The second category includes the queries issued from mobile or fixed terminals and querying data related to moving objects (such as vehicles, helicopters, boats, people). For example, "select all ambulances that will be at 2 km from the hospital within 10 minutes." Within these two categories we can distinguish different types of queries according to their location dependence, to the association of spatial and temporal dimensions and to the evaluation mode (continuous or not).

The main objective of this chapter is to review work related to mobile queries (i.e., queries issued by mobile terminals and/or querying data related to moving objects). We start by classifying the different types of mobile queries. This step is central because it allows us to highlight the constraints of each type of query and to identify their underlying problems. In the field of mobility, various topics and problems were addressed by several different research communities. We only present the problems generated by the requirements of the new types of mobile queries. Finally, we point out the still open problems and identify the new challenges related to query processing in mobile environments.

QUERY CLASSIFICATION

Context

In mobile environments, entities can be either fixed or mobile. Hence, defining what mobility means is an essential requirement:

- **Mobile Client:** The query is submitted by a mobile terminal, here called mobile client.
- **Mobile Server:** The query or part of the query is processed at one or several mobile servers.
- **Moving Object:** Data targeted by the query can represent, in databases, moving objects (e.g., vehicles).

In this context we can highlight some query classification criteria. The first is the mobility constraint which allows distinguishing two basic forms of queries: (1) queries submitted by mobile terminals and querying data related to fixed objects (e.g., hotels), and (2) queries submitted by mobile or fixed terminals and querying data related to moving objects.

Notice that the mobility of servers does not add additional types of queries. Nevertheless, it may have an impact on query execution models since other problems have to be considered (e.g., network connection, server localization, etc.) (Holliday, Agrawal, & Abbadi, 2002).

For both query categories mentioned above, other types of queries could be distinguished. In fact, a second criterion, location constraint, brings out three types of queries: *Non-Location-Related Query*, *Location-Aware Query*, and *Location-Dependent Query*. The third criterion