

RETINA: A Real-time Traffic Navigation System

Kam-Yiu Lam¹, Edward Chan¹, Tei-Wei Kuo², S.W Ng¹ and Dick Hung¹
Department of Computer Science¹ Department of Computer Science and
City University of Hong Kong Information Engineering²
83 Tat Chee Avenue, Kowloon National Taiwan University
Hong Kong Taipei, Taiwan, ROC

Email: {cskylam|csedchan}cityu.edu.hk

Email: ktw@csie.ntu.edu.tw

1. INTRODUCTION

The objective of RETINA is to study the important issues in the design of a high-performance soft-real-time information system over a wireless network, where the real-time constraints of data items can be met, and the critical queries can be processed within the system/user requirements. The design of the system involves the technologies developed in the fields of real-time systems and mobile computing, such as data similarity, mobile transaction management, the processing of location-dependent queries, and the processing of continuous queries. The two basic services of RETINA are: (1) to provide real-time traffic information to mobile clients according to their current locations, and (2) to provide path-searching and navigation functions to mobile clients so that they can arrive at their destinations within the deadlines. In the system, the best path to a destination is calculated based on the roads connecting the starting location and the destination, and the *real-time* traffic conditions of the roads. In the calculation of the road traffic, future traffic conditions are predicted and used.

2. SYSTEM ARCHITECTURE

In RETINA, the whole service area is divided into cells and a traffic information server is defined in each cell. Each mobile client is preloaded with a set of road maps and is connected to a location detection device. They connect to the server of their current cell by a mobile network.

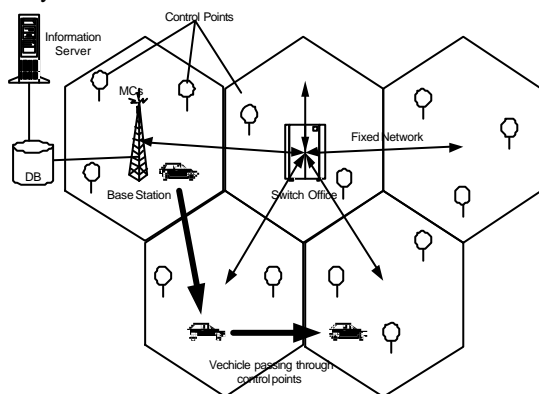


Figure 1: System Model

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

ACM SIGMOD 2001 May 21-24, Santa Barbara, California, USA
Copyright 2001 ACM 1-58113-332-4/01/05 ...\$5.00.

Depending on its current location, a road map will be loaded. Each map is labeled with a set of control points whose values are obtained from the information server at its current cell. A mobile client periodically generates a location-dependent query, which contains the current location of the client, to its current server.

If a mobile client is in the navigation mode, it may send a location-dependent continuous query to its traffic information server to invoke the path-finding function by providing its destination. The path-finding function calculates the best-connected path for going from the current position to the destination based on the connections of the roads as well as the current and future traffic conditions of the roads. While the mobile client is following the defined shortest path (as suggested from the server), the traffic server may re-calculate the path if the current traffic of the roads is “significantly” different from that at the time when the previous calculation is made.

3. DESIGN ISSUES

In the design of the system, four important issues are addressed:

- (1) The processing of traffic updates and the management of real-time road traffic data;
- (2) The distribution and the management of cached traffic data;
- (3) The derivation of the shortest path; and
- (4) The dissemination of data and the processing of queries.

In management of traffic data, three versions are maintained for each data item. Based on the versions, we predict the future value. In dissemination of traffic data, the periods of the requests from clients depend on how the values change.

4. DEMONSTRATION

A simulation testbed is developed to demonstrate the functionality of RETINA and the capability of the designed methods for managing the real-time traffic data. A database containing the road connections is defined in the database. Two servers are setup, and each server is assumed to be responsible for a region in the system. Traffic is generated by a process to simulate the new traffic updates from the control points. The location of a mobile client is generated by another process at a handheld PC. The process generates continuous requests for navigation and requests for asking the real-time traffic of the surrounding area of its current location. The process also simulates how it moves while it is following the suggested path.

5. ACKNOWLEDGMENTS

The work described in this paper was partially supported by a grant from the Research Grants Council of Hong Kong Special Administrative Region, China [Project No. CityU 1078/00E] and a research grant from National Science Council, Taiwan, ROC, under Grant NSC89-2213-E-002-200.