Real-time information on road traffic based on Floating Car Data

Laurent Breheret, *Sodit, France*

BIOGRAPHY

Laurent BREHERET is General Director of SODIT Company. He got an engineer degree from ENSEEIHT (France) with specialisation in automatic control (1988) and a Master (Mphil) in transportation from University of Southampton (UK). Since 1991, he has been strongly involved in R&D Projects and participated to many projects covering topics such as: road traffic management, traffic control, real-time information, public transport, security in transports and simulations.

INTRODUCTION

This paper presents the preliminary results of the SINERGIT project, which objectives are the development and the demonstration of a cooperative information system covering road and urban networks. The system aims at optimizing traffic management means, and at providing real-time information on driving conditions to all drivers using up-to-date personal navigation devices.

The application uses three different sources of data, which are centralized in a server. The first set of data comes from existing traffic monitoring systems, which are currently using buried sensors measuring traffic flows and speeds. These monitoring systems are belonging to and managed by local authorities and roads or motorways operators.

The second set of data is provided by the Telecom operators who are able to localize usual mobile phones. Movement of a cellular phone is detected and recorded when changing from at a cell to another and this information might be used in an anonymous way as an input to a traffic assignment model. Among the results, this mathematical model gives flows and travel times.

The third source of data is the tracking of PND (personal navigation devices), smartphones or PDA with embedded augmented GNSS receivers. In that case, the precise position of the vehicle, plus some other indicators, can be sent to the central application. This category of FCD (Floating Car Data) is used to measure the average speed of the traffic flow, and to estimate overall traffic conditions. According to the device used, different levels of confidence on the positioning can be defined.

The role of the central system is to merge the 3 sources of data by the way of a series of fusion models, in order to elaborate the best (according to coherence and quality criteria) traffic information, which can then be dispatched in real-time to all drivers. A back-office application also provides statistical traffic information to the destination of road and transport authorities for study purpose.

The project started in April 2007 for a 2-years period. A first limited demonstration was available at mid-term (April 2008) for the Toulouse Space Show 2008. A larger demonstration is planned end of 2008.

THE ORIGINAL CONCEPT

In Toulouse, as in most of cities, road traffic is growing and generates more and more saturation problems of the road networks. A better understanding of the traffic situation and of its evolution in future is a great expectation from all stakeholders: public services, infrastructure managers, services providers, and generally all road users.

The challenge of SINERGIT is to propose an efficient platform for real-time information on traffic status and dissemination of travels times on extended network.

The main target of the SINERGIT platform is to provide a better understanding of real-time traffic situation in the Toulouse Region and to disseminate useful information for a better mobility.

The SINERGIT platform will merge the data supplied by heterogeneous sources (fixed sensors, floating car data and mobile phones) in order to generate dynamic and high quality traffic information on a large geographic area, covering urban, suburban and interurban road networks.

THE OBJECTIVES OF THE SYSTEM

SINERGIT platform relies on multiple sources of data containing information on traffic conditions: fixed sensors, floating car data, tracking of personal navigation devices and cellular phones data (GSM).

The collected data are combined together with a powerful model, giving qualified and real-time information for the mobility of persons: saturation level of the road network and travel times.

As a result, the SINERGIT system will cover the greater Toulouse conurbation.

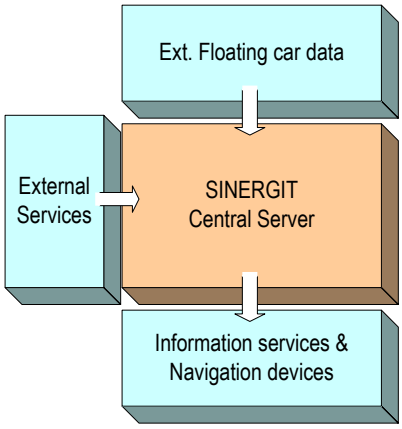
SINERGIT is innovative by the use of multiple sources of data, the data fusion model, the travel time estimation and the large coverage of the road network.

HOW IT WORKS

The SINERGIT platform aims at optimising the supply chain of data for the information services on mobility of persons.

The full system is composed of the following physical components:

- The extended floating car data, (XFCD)
- The central server
- External services
- The information and navigation devices



External services include the public authorities and the road operators. They provide data regarding the traffic events, and rough data from 1338 fixed sensors, such as vehicle counting and speed on major streets and highways.

The extended floating car data are provided by two components:

- Some smartphones (i.e. mobile phone with embedded GPS receiver) specially adapted, are sending regularly their position while moving.
- The Telecom operator is collecting handover data of cellular phones, which is used to estimate the travel time between phone cells.

Neither navigation devices nor information services are part of the Sinergit system. Sinergit platform is feeding other Internet dedicated services and classical navigation devices with up-to-date traffic information.

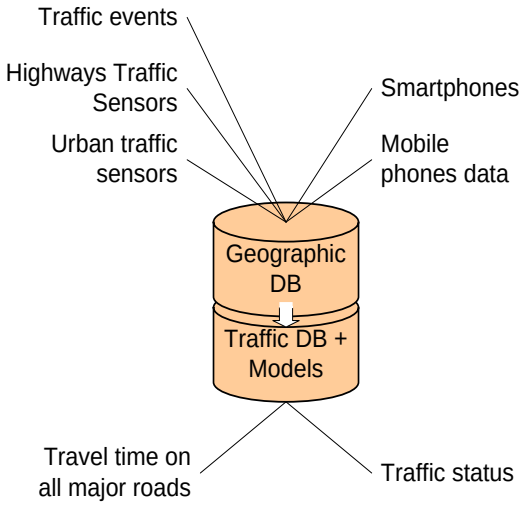
The core of the Sinergit platform is the central server, which is composed essentially of:

- The data flow manager, collecting information from different sources, map-matching geographical data and storing relevant data in a database;
- The main server, including all functions such as the merging of heterogeneous data and the computation of the traffic information as well as the quality indicators.

THE DATA MERGING AND TRAVEL TIME ESTIMATION INTO THE SINERGIT PLATFORM

The information collected by the Sinergit central server is from different nature.

- A large part of the data is directly linked to one or several road sections (traffic events, vehicle counting, speed, link occupancy). These data are updated regularly, with a sampling time of 3 or 6 minutes, according to the provider, all day long. They are representing an average of the traffic situation on one spot.
- The other category of data, issued from floating cars and mobile phones tracking, is not directly attached to the road network. They represent an average of individual travel times, on a series of itineraries. These data, representing the mobility of users, have first to be map-matched on the road network. When doing this process, we introduce some uncertainty on the positioning of the person/vehicle. In that case, it is important to have a high quality positioning, using for instance GNSS signal augmentation or Egnos integrity facility.



At a first stage, the data flow manager applies a filtering model, in order to detect any wrong data or incompatibility with the physical phenomena of traffic (speed too high or too low, number of vehicles inconsistent with the capacity of the road, incompatibility of data, etc.).

The second stage of the data processing consists in transforming heterogeneous data in comparable information. The most obvious and understandable parameter has been chosen: the travel time on elementary links. To achieve this process, we apply several well-known traffic models, according to the type of road (urban, highway, rural road). At the same time, it is important to compute an indicator of the quality of the travel time. This indicator might depend on the sensing method or on statistical approach.

The following step consists in merging different values of travel time obtained for the same road section, taking into account the relative quality indicators. A propagation model is also necessary to infer the travel time on road sections where no data is available, as well as traffic status.

All these steps are achieved in real-time, every 6 minutes, and feed an information server. The final traffic information is displayed on a comprehensive map (using a GIS) and made available on a web server.

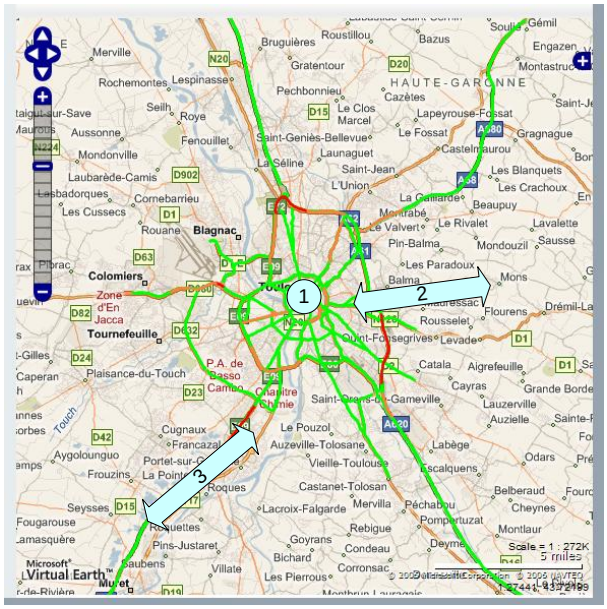
THE PARTNERSHIP

A strong partnership has been formed to achieve the Sinergit system:

- Sodit carries out the project coordination and develops of the integrated platform;
- Thalès Alenia Space provides the platform dedicated to the tracking of smartphones;
- France Telecom R&D analyses and forwards the travel times computed from GSM data;
- Inrets works on the fusion models;
- Polestar implements a GNSS augmentation solution inside the smartphones;
- ASF, Cete Sud-Ouest and City of Toulouse are providing traffic data and traffic events.

PRELIMINARY RESULTS AND SERVICES OFFERED

As the information is displayed on a web server, end-users may access dynamically the traffic information via any browser or mobile phone. It is not the purpose of Sinergit to publish nice-looking web sites, but only to provide content to any existing traffic and travel information server, as there are numerous on line.



The traffic information is available on urban①, suburban② and interurban③ road networks

It is also important to notice that all statistical data are made available for post-treatment to any public authority and road manager/operator. Thus, the Grand Toulouse, the city of Toulouse or the ASF motorway company will have an instant access to real-time and to statistical information on traffic situation in any part of the network. This global vision of the traffic conditions allows many services such as studying the evolution of mobility on the conurbation, studying the impact of a new public transport service or a new road infrastructure …

ACKNOWLEDGEMENTS

SINERGIT obtained in 2006 the labels from two competitiveness clusters: *Aerospace Valley* and *Advancity* (Ville et Mobilité Durable).

The project started in 2007 and will mid of 2009, covering completely the road network around Toulouse city.

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