NEXTGENITS PROJECT IN BELGIUM
HOW TO COPE WITH DYNAMIC SPEED INFORMATION

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ABSTRACT

As the first steps on ISA in Belgium are taken, the need for an accurate speed limit database is growing. Based on studies to reveal available speed limit information on higher and lower (municipalities) level, and taking into account European guidelines and standards, a dynamic speed limit database is being developed. Furthermore a framework is constructed for the distribution and updating of this speed limit database and for the provision of real-time speed information in vehicles (dynamic ISA). The research is part of the NextGenITS project that aims to implement several ITS services presented in an integrated demonstrator for Flanders.

KEYWORDS
Intelligent speed adaptation (ISA), speed data availability, dynamic speed limit database, ISA architecture

INTRODUCTION

Many initiatives are made on European and national level to develop a speed limit database. These databases are needed in a further development of "speed management". Speed management [11] can be described as an integrated well defined approach of measures on infrastructure, signs and signing, vehicle technologies, education and training, enforcement and the use of intelligent transport systems (ITS). One of the most promising ITS to reduce inappropriate speed are Intelligent Speed Adaptation (ISA). ISA involves a traffic safety device that warns the driver about speeding, discourages the driver from speeding or prevents the driver from exceeding the speed limit. These systems can only function if an accurate speed limit database is built.

Within this approach of a dynamic use of ISA, where speed limits are communicated to vehicles in both time and space, an accurate framework for a dynamic and updatable speed limit database is a necessary condition. This paper describes a project that is dedicated to the technical feasibility of this dynamic and updatable speed limit database for the use of speed warning systems. In a first section a brief overview is given about the initiatives on ISA in Belgium. In the next section the developments in Europe and in other countries are described

as well as how Flemish municipalities cope with speed limit information. In the last section the framework for a dynamic use of speed limit information is given.

ISA IN BELGIUM

1. Acceptance of ISA to the general public

Already in 1998 a questionnaire [1] was put to the general public about ISA. Forms were sent to 4820 randomly selected road users in Belgium. 2507 people answered. The aim of the questionnaire was to reveal if acceptance of ISA is feasible. The respondents were asked about the use of traffic accommodation, behavior and attitudes in relation to speed, the experience of speed and speeding and opinions on measures of road safety.

This research indicated on average, that the road-users were 'responsible' drivers aware of the relation between speeding and road-unsafety. They wanted measures against speeding and were mostly in favor of a traffic-safety policy. It also indicated that there is a possible acceptance of 'advanced road-safety utilities' especially in relation with speed and speeding-behavior. Therefore the respondents were also asked about their opinion of an implementation of ISA. 63% of the respondents agreed with an implementation of a mandatory ISA-system. 62% agreed about a voluntary system.

2. First ISA-trial in Belgium

According to the results of the large questionnaire a first ISA-trial was introduced in Belgium [2]. It started in October 2002 and ended in January 2004. 34 cars and 3 buses were equipped with the 'active accelerator pedal.' When the driver attempted to exceed the speed limit, a resistance in the accelerator pedal was activated. 80 people volunteered to install the ISA system in their privately owned car. From those 80, 20 were withheld. An additional 17 cars were provided by different kind of companies. The total (restricted) number of test drivers was 62: 42 male and 20 female spread over different ages and different cars.

All drivers (total) accepted the active accelerator pedal. After the trial they experienced the pedal as being even more satisfying. The most pleased with the active accelerator pedal were the private drivers. During the project they found it more useful but less satisfying than after the project. The most remarkable change is seen by the non-private drivers: while during the project they experienced it was not satisfying, although useful, they declared it was more satisfying and useful after the trial. At the end of the trial, the private test-drivers could choose to keep the ISA-system in their car. 15 private car holders chose to keep the system in the vehicle after the test-period which is a significant indication that there is an acceptance of the active accelerator pedal. The main reasons given for keeping the system was that it was assisting, comfortable and relaxed driving.

During and after these trials many demonstrations were given with a special equipped demonstration-car to policy-makers. A lot of local authorities wanted to have ISA but the main problem was to have and to gather speed limit information [3]. The availability of speed limit data and methods to construct a database needed investigation.

THE OUTSET OF A SPEED LIMIT DATABASE

In 2005, the Flemish Government demanded a study to set up recommendations for the construction of a Flemish speed limit database. The study included an inventory of available information on municipalities, an overview of relevant European projects and an investigation of national initiatives.

1. European activities

Preceding the construction of a Flemish Speed Limit Database, a close look was taken at research activities funded by the European Union which are of great use in the development of a speed limit database. The aim of EuroRoads [8] was to create a pan-European standardized, seamless, updated and quality assured digital road data infrastructure. The structures and mechanism defined are valuable for further projects like ROSATTE. The ROSATTE [9] project intends to develop enabling infrastructure and supporting tools to ensure European access to, as well as continuous update of safety-related road attributes (essentially speed limit and traffic signs). SpeedAlert [4] investigated and developed a framework to support the implementation of in-vehicle speed alert applications that can contribute to improve road safety. In the MAPS&ADAS [10] subproject of PREVENT the use of digital maps as primary and/or secondary sensors for Advanced Driver Assisting Systems (ADAS) was investigated. In the research of ActMAP [7] mechanisms for online incremental updates of digital map databases in the vehicle was investigated and created.

In addition to these European projects, national initiatives were investigated and considered as useful for the creation of the Flemish speed limit database [3]. In Sweden and Finland the speed limit database is a part of the national road database. In Denmark the registration is based on all speed signposts, and in the Netherlands a speed limit database has been made available on the internet which should become 98% accurate in two years.

2. Availability of data on municipalities in Flanders

Initial information for a speed database in Flanders can be found at the municipalities. Because of this a questionnaire was send out to all Flemish municipalities in 2006 to investigate the availability of speed data [3]. Of the 191 municipalities that responded, 38% claimed to have speed limit data in one form or another. 14% of all responding municipalities would have the data stored in a database, whereas 24% would have the data in some other form like a textual description or drawn on a map.

A second questionnaire was send out in 2009 to investigate the current situation of speed information maintained by the municipalities. Preliminary results show an increase of available information. Of the 217 municipalities that responded, 59% would have speed limit data, and 23% of all responding municipalities would have the data stored in a database. In a time period of three years more useful speed information seems to be available.

Figure 1 shows the change between available speed data in 2006 and 2009. Four categories can be distinguished. A first category represents municipalities which have speed limit data available in a database. This type of information is the most valuable. Other municipalities have speed limit available in some other form, which is not as user friendly, and finally some

municipalities do not have speed limit information available. For some municipalities no information was obtained.

Nevertheless some municipalities (Bocholt, Geel) claimed to have speed data available in 2006 whereas the results of 2009 show the opposite. Further research needs to elucidate such anomalies. Apparently results can vary depending on the person who was responding, which can be different from the administrator of the data.

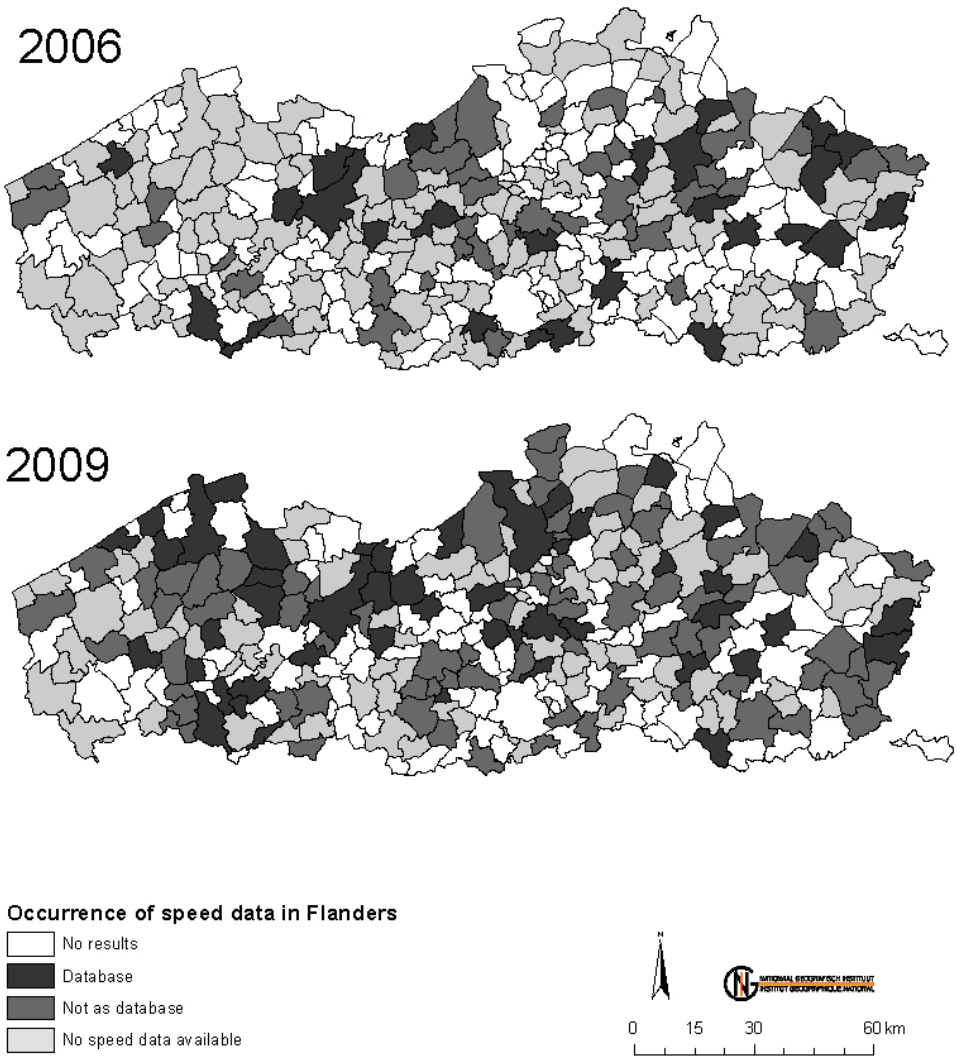

Figure 1 - Occurrence of speed data in municipalities of Flanders

The questionnaire send out to all Flemish municipalities in 2009 shows that 86% of the respondents is willing to manage a speed limit database if the government would put the data at their disposal. 73% is willing to update the database.

All this shows a certain basis is present in Flanders to start the creation of a speed map. The quality and standards of the collected speed data can be tested and demonstrated within an ISA application. A project to create a test-bed on future ITS developments in Flanders, including ISA, is called NextGenITS.

3. Zero measurement on all municipal roads

The Flemish government started to make an inventory of all the traffic signs along the highways and regional roads in 2004/2005. Besides these 13000 km of roads that will be inventoried by mid 2009, the Flemish Government also plans to make an inventory of the traffic signs along the remaining 55000 km of municipal roads. The Flemish Government will take the lead in carrying out the zero measurement on all municipal roads. The purpose is to have the database by 2010. It will then be essential that all road authorities co-operate to keep the established database up to date.

FRAMEWORK FOR A FLEMISH DYNAMIC SPEED LIMIT DATABASE

Based on European initiatives and the upcoming road sign database it is essential to know how these data can be used related to the implementation and use of ISA. The issue of incremental and dynamic map-updates will be studied in the NextGenITS project. The project [5] is a cooperation between prominent players in the Belgian ICT sector, research institutes and governments and aims to implement and demonstrate the following ITS services: traffic information, e-call, Road Tolling, services based on vehicle-to-vehicle and vehicle-to-infrastructure communication (cooperative systems) and ISA. Furthermore specific research will be done to integrate the different applications in a generic multi-application platform. All applications will be based on European standards to ensure interoperability across geographical borders and between different manufactures.

1. Practical use of speed data in the Flemish context

Based on the studies conducted on ISA, an architecture (Figure 2) is designed to define how the speed data of local authorities fits in a Flemish speed database and how the speed data is communicated to the vehicle [6]. The major components needed to achieve this are the content centers, the traffic control center, the speed database control center, the service center and the client system.

1.2. Managing real-time speed information

The speed limit can vary depending on road, traffic and/or weather conditions, or dependent on the time period of the day. All relevant information is provided by the **content centers**. Public road authorities collect data about the current traffic situation and/or road conditions which determines the current fixed, variable and temporary speed limits. In this architecture, several content centers can be implemented and be operational at the same time.

A specific type of content center is the **Traffic Control Center**. It monitors the major roads and is responsible for the speed limit management by generating, calculating and updating the speed limits for these roads. Next these speed limits are communicated to the **Speed Database Control Center**. A preliminary version of the Flemish road sign database can be used to maintain and update speed limits in a Speed Database. Future developments in the ROSATTE project are closely watched to detect corresponding standardized procedures to ensure a European access to road safety attributes and incremental updates.

The **Speed Database Control Center** receives the most recent speed limit information. As a consequence it has the final speed limit database at its disposal. This database is composed by the speed limits of the local database and completed with up-to-date fixed, temporary and variable speed limits originating from the Traffic Control Centre. The Speed Database Control Centre is responsible for the maintenance and management of the speed and road sign.

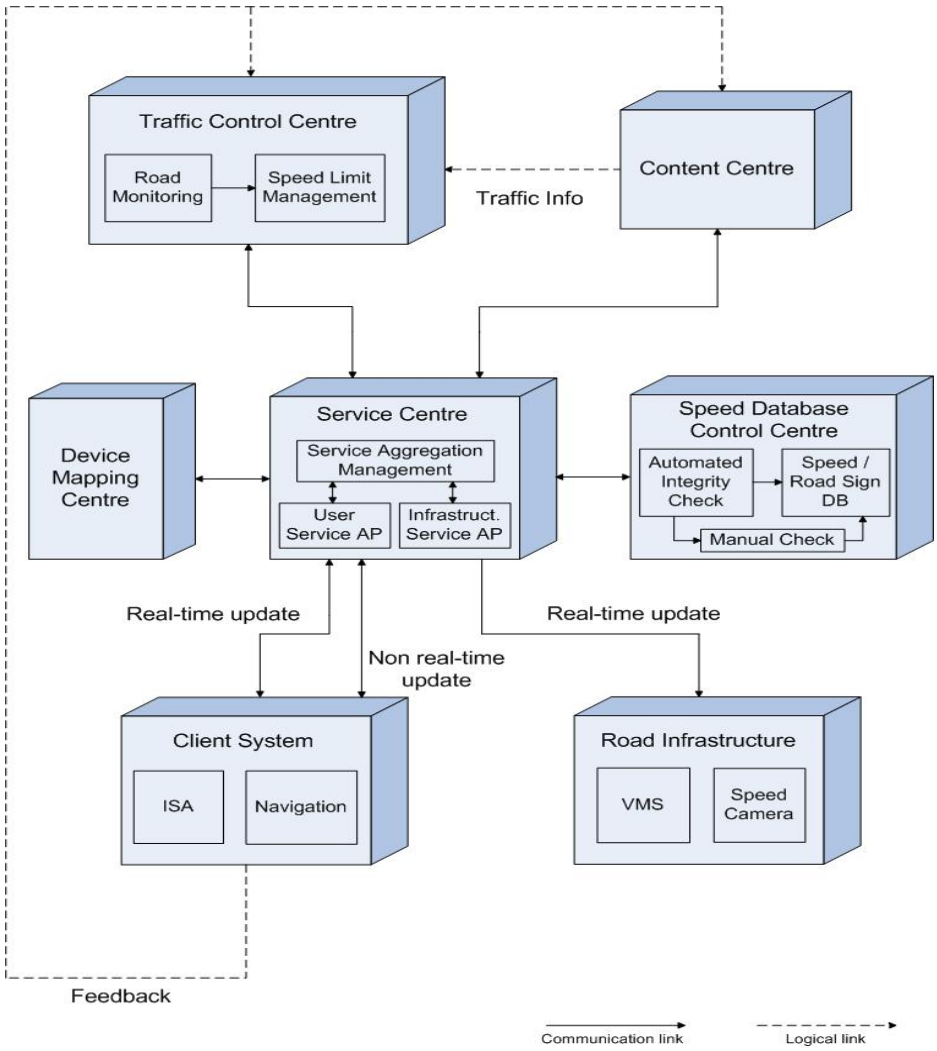

Figure 2 – ISA architecture

1.2. Updating the in-vehicle information

Before sending updates from the Speed Database Control Centre to the Client System, the speed data needs to be processed by the Device Mapping Centre, since end-devices (which inform the driver of speed limit information) from different manufactures can use different data formats. The **Device Mapping Centre** is an entity that is responsible for the translation of generic updates coming from the speed database to end-device specific formats. Similar specifications for online incremental updates of in-vehicle map databases are defined in the ActMAP project [7]. However the ActMAP framework is unlikely to be used in the future. Possible solutions can be found in the PSI format as a navigation data standard.

The coordination of the whole system is managed by the **Service Center**. All entities in the architecture only have to know and communicate with the service centre to cooperate with all other entities. The Service Center provides temporary and updated speed limits to the client systems.

The **client system** runs several applications that need map information, including the ISA application. The device receives the updates from the service centre. The updates could be received by two different methods. First the updates could be received non real-time (e.g. wifi link at fuel station, at home …). In this scenario, there is no guarantee that the map information is always up to date. A second manner is by so called real-time updates by which there is real-time communication between the service centre and the client system about temporary speed limits. In this scenario, maps are always up to date.

2. Making a demonstrator

To accelerate the introduction of ITS in Flanders and prepare the industry for the European and global ITS market, the research will be applied by means of a demonstrator.

The demo infrastructure consists, beside the communication infrastructure, of two main components: the client application and the operator application. The operator application is a visualization of a digital map and has three important functions. First the map will continuously show an updated location of a tracked emergency vehicle (track & trace). Secondly an incident notification tool will show icons which indicate incidents on the map. These warnings, for example a black ice spot or a traffic jam, are received by the operator from vehicles on the road. This illustrates one aspect of the cooperative system application.

Thirdly an operator can change the speed limits of the roads displayed on the map. The in-vehicle client application shows several icons with respect to dynamic traffic information. Additionally the current traffic situation is checked to demonstrate the traffic information application.

CONCLUSION

In the scope of the NextGenITS project, an ISA subproject is set up as a beneficial instrument to environmental and road safety issues. The construction of a speed database, which contains all speed limit information, is a necessity. Some speed limit data is available within the municipalities, and has increased over the last three years. In addition the development of the Flemish road sign database can be seen as a valuable source for the construction of an ISA application.

Speed limit information needs to be up to date. To do so in a real-time manner, the speed limit database is constructed so it is able to manage dynamic data. Like this it becomes possible to handle variable and temporary speed limits.

The architecture presents the way in which the ISA system will be deployed. It creates the possibility to change a speed limit which will be handled by a speed limit control center as a generic update. From there a device specific format can be set up which can be send to the in-vehicle client system. A service center coordinates the whole system. To present the project to

the public, a demonstrator that integrates ISA, traffic information and cooperative systems will be set up. Relevant European projects such as ROSATTE are followed closely to determine useful guidelines and standards.

ACKNOWLEDGEMENT

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