Towards ISA deployment in Europe: 
State of the Art, main obstacles and initiatives to go forward

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Abstract
In the early 2000s many projects for assessment of intelligent speed adaptation systems (ISA) took place in Europe. The results of these experiments showed that significant benefits for road safety can result from ISA and that driver acceptance can be considered for deployment. However, nearly 10 years after the first experiments, no system is actually deployed in Europe. First, we will present an inventory of major evaluation projects of ISA in Europe with a focus on the French LAVIA experiment. These projects have mainly helped to improve knowledge about systems effectiveness and impact on road safety as well as driver’s behavior and acceptance. These projects also highlighted a number of obstacles for deployment especially the difficulty of building and updating the speed database. Several projects such as SPEED ALERT ACTMAP, FEEDMAP, ROSATTE and the ADASIS Forum have provided some answers to these important issues. They will be presented in the second part of this paper. French initiatives will be presented in the sequel: the BALI project which aims to build a speed database throughout the Yvelines County located near Paris and the COSAL demonstrator which provides solutions based on cooperative systems for updating in real time the in-vehicle database. Finally, beyond these technical aspects, there is a system that must be operated by private or public, and an economic model to find. We will try to shed some light on this open issue in the latter part of this article including recent private initiatives involving user communities.

Keywords
ISA, speed, database, cooperative systems, deployment, updating, demonstrator

Introduction
In the early 2000s accident analysts both in France and abroad all agree that speed both causes accidents and increases their severity. In France, accidents that involve a single vehicle or a single vehicle and a pedestrian accounted for 35% of injury accidents and 45% of fatal accidents in France. In many cases they were caused by unsuitable speed. In built-up areas, 70% of pedestrians who were hit by a vehicle travelling at over 50 km/h were killed. 80% of them would survive if the vehicle were travelling at 30 km/h at the time of the impact. In spite of this, speed limit compliance was poor. More than 60% of drivers did not comply with speed limits on urban roads or trunk roads. However the worst situation was when a trunk road passes through a village. Here 80% of drivers broke the speed limit.

Reacting to excessive speeds
Studies conducted on road speeds are widespread, both in France and abroad. Results tend to converge and allow postulating that a lower level of speed, with all other parameters held constant, does lead to a drop in both the frequency and severity of road accidents.

In France, the introduction of radar devices has provided a clear and well-documented demonstration (Figure 1), should there be any lingering doubts, of the impact from greater respect of safe-driving speeds, given the sizable decreases in the number of fatalities (from more than 8,000 a year prior to the introduction of radar to under 5,000 following deployment). Moreover, the availability of Automatic Speed Regulators has spurred demand among drivers to acquire "LAVIA" type systems, which could serve as a tool to ensure heightened respect of speed limits, could helps avoid incurring traffic fines and having points docked from the driving license.

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Non peer-reviewed extended abstract
Initial driver training, repeated awareness campaigns, surveillance and sanction are all necessary, but they are not enough to reduce driving speeds significantly. New technology and the technical advances made by cars manufacturers and equipment suppliers mean that vehicles can now be fitted with systems that can help the driver to comply with speed limits and also provide genuine driving comfort. This has led to testing in several European countries Intelligent Speed Adaptation Systems.

Overview of some trials in Europe

Early work in this area is probably those carried out in France by Malaterre and Saad in 1984 on a vehicle with a speed limiter adjustable by the experimenter or the driver [1]. Research has demonstrated benefits for road safety but poor acceptance probably due to ergonomics, but also to attitudes in force at that time.

Regarding larger scale experiments, most advanced European countries were Great Britain, the Netherlands and Sweden. Beyond the significant results they brought, these experiments were very useful for designing the French experimentation.

In England, a research program entitled EVSC (External Vehicle Control), led by researchers of Leeds University, was launched in 1997 [2]. The project combined tests on simulator and on open road ISA equipped vehicles operating in several modes: advisory, active voluntary (or overridable), active mandatory. Based on analysis of collected data, the researchers estimated the reduction in fatalities and injuries over a period of 60 years with an increasing penetration of ISA (Table 1).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advisory</td>
<td>9%</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Voluntary</td>
<td>25%</td>
<td>19%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Mandatory</td>
<td>44%</td>
<td>40%</td>
<td>25%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Table 1 – percentages of accident reduction over period 2010-2070 (source EVSC final report)

It is undoubtedly in Sweden that was conducted the largest experimentation [3]. Some 5000 vehicles equipped with different kinds of ISA (advisory or active) have been tested in 4 cities of Sweden (Borlänge, Lund, Lidköping, Umeå). Among them, about 600 vehicles (Borlänge, Lund) were equipped with data logger. The results of these tests concluded on a 20% reduction of road injuries and a significant speed reduction, especially when approaching intersections. Travelling times were not affected by the use of the system in urban areas because it was shown that ISA induces a smoother driving behavior and causes less stopping and braking situations. Finally acceptability is high especially in urban areas. About two in three drivers were ready to keep the system if it was free while about one in three would have been willing to pay a limited amount.

In the Netherlands [4] an experiment involving 20 passenger’s cars and a bus equipped with ISA took place between 1999 and 2000 in the city of Tillburg. Forty drivers were involved in this experiment; each...
driver tested the system for 8 weeks. The test area mainly urban and residential included speed limits of 30, 50 and 80 km/h.

<table>
<thead>
<tr>
<th>Speed limit (km/h)</th>
<th>V95 without ISA (km/h)</th>
<th>V95 with ISA (km/h)</th>
<th>Difference (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>44.4</td>
<td>28.9</td>
<td>-6.7</td>
</tr>
<tr>
<td>50</td>
<td>57.0</td>
<td>47.3</td>
<td>-9.7</td>
</tr>
<tr>
<td>80</td>
<td>77.9</td>
<td>75.1</td>
<td>-2.8</td>
</tr>
</tbody>
</table>

Table 2 – 95 percentile speed value for all test zone road section

A few weeks after the beginning of the experiment, the drivers were asked about their preference between limited or unlimited speed driving. Most drivers were undecided and even at the end of the experiment or several weeks later the results were quite similar: half the drivers preferred a speed limited driving and the other half the opposite.

Acceptance also depends on road areas and their speed limitations as shown in Table 3. The poor score in 18 km/h areas is due to difficulties with the transition between 18 and 30 km/h, which finally leads to abandon the 18 km/h speed level. The scores of the other zones are quite similar and show a good level of acceptance (more than 60% of positive opinions).

<table>
<thead>
<tr>
<th>Appreciation</th>
<th>18km/h area</th>
<th>30 km/h area</th>
<th>50 km/h area</th>
<th>80 km/h area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>63%</td>
<td>22%</td>
<td>18%</td>
<td>7%</td>
</tr>
<tr>
<td>Neutral</td>
<td>25%</td>
<td>18%</td>
<td>20%</td>
<td>8%</td>
</tr>
<tr>
<td>Positive</td>
<td>12%</td>
<td>60%</td>
<td>62%</td>
<td>85%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3 – Appreciation of speed limited driving in different speed areas (40 drivers)

In Belgium [5], an experiment was conducted in 2002 involving 34 cars and 3 buses equipped with a system similar to Swedish: an accelerator pedal that is becoming increasingly resistant when attempting to exceed the speed limit (AAP = active accelerator pedal).

<table>
<thead>
<tr>
<th>Speed limit</th>
<th>Km driven</th>
<th>AAP inactive</th>
<th>AAP active</th>
<th>Change in</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>SD</td>
<td>V85</td>
<td>V</td>
<td>SD</td>
</tr>
<tr>
<td>30</td>
<td>5569</td>
<td>23.8</td>
<td>11.4</td>
<td>39</td>
</tr>
<tr>
<td>50</td>
<td>95,509</td>
<td>30.9</td>
<td>14.9</td>
<td>49.9</td>
</tr>
<tr>
<td>70</td>
<td>13,297</td>
<td>47.5</td>
<td>19.3</td>
<td>71.3</td>
</tr>
<tr>
<td>90</td>
<td>17,194</td>
<td>69.1</td>
<td>19.3</td>
<td>89.4</td>
</tr>
</tbody>
</table>

Table 4 - Driving speed average (V), standard deviation (SD) and 85 percentile (V85) of test area

Table 4 shows changes in speed with and without use of the AAP. We observe that the average speed is little changed while the v85 decreases of 2.5 km in 30, 70 and 90 areas. V85 is more representative because little affected by extreme fast speeding.

The French LAVIA project

Following experiments in Sweden, the Netherlands and England, French public authorities decided to test the system LAVIA [6] in 2001 with the following objectives: testing the acceptability and system use patterns among drivers in all its various operating modes, evaluating changes in individual behavior, with special emphasis on measuring the induced decreases in speed or deviations from posted speed limits and estimating the overall combined impacts on user safety. To proceed, an experiment was set up involving some one hundred volunteer drivers over an extensive zone of investigation located for the most part within the Yvelines County (approx. 1,000 km of highways and streets) west of Paris.
Input data spanned a wide array of sources: interviews, questionnaires, feedback sessions, automated information collection. The data set generated was then analyzed by a multidisciplinary team composed of psychologists specialized in driving behavior, statisticians and urban planners among others.

Eight partners collaborated in this project: the French car manufacturers Renault and PSA, the Accidentology and Biomechanics Laboratory (LAB) and nonprofit organization: the Southwest and Mediterranean Regional Public Works Research Centers (CETE), the Paris Regional Public Works Division (DREIF), and the INRETS and LCPC public research institutes.

Automakers built a fleet of 22 vehicles equipped with LAVIA that could run according to the three following modes: 1) advisory: commonly-encountered speed limits are indicated on the vehicle dashboard, on which an indicator light starts to blink if the driver exceeds this limit; 2) voluntary active: beyond the authorized speed limit, the accelerator pedal is no longer efficient, yet LAVIA does not engage the brake. The driver can switch the ON/OFF button to activate/deactivate the system on demand; 3) mandatory active: identical to the previous mode except that the driver is not given the possibility to manually override the system. In both of the active modes, the driver was able to temporarily neutralize the system by means of flooring the accelerator pedal (the kick-down or “KD” maneuver). The system then becomes reactivated once vehicle speed returns below the speed limit.

Technically, the LAVIA was based on a navigation system coupled to a digital map including speed limits.

A first survey involving 1000 drivers had the objective to better understand the opinions and attitudes on speed and driving assistance that help to comply with legal speeds. 500 drivers were asked (from among the initial 1,000 sampled) whether they would accept to participate in the experimental stage of this research program: 192 affirmative responses were received. Due to a delay between this survey and the experimentation starting it was necessary to conduct a second survey for two reasons: first the drivers panel had weakened over the time and second deployment of speed camera occurring in 2003 have influenced opinions. Then the remaining 91 volunteers were then combined with a sample of another 100 volunteers selected using the same sampling distribution basis as the initial survey.

Then after a phase of technical validation, testing was conducted in two stages:

- a pre-evaluation involving 12 drivers which aims was to detect problems that could affect the acceptability, difficulties in using the system, the technical adjustments to make and also to define the experimental protocol for the second step;
- the evaluation itself involving 92 drivers in naturalistic driving conditions. A vehicle was loaned to each driver for 8 weeks cut into 4 sequences: no system, advisory only, active voluntary and active mandatory system.

During these tests, data driving parameters were recorded. Moreover, the pre-evaluation was conducted on two heavy instrumented vehicles to make video recordings of front and back road views and driver’s face.

It is not possible in this article to make a comprehensive presentation of results that can be found in [6][7][8][9]. We will focus on a few significant results.

<table>
<thead>
<tr>
<th>Type of road</th>
<th>Urban road</th>
<th>Rural road</th>
<th>Motorway</th>
<th>Total trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver's speed &lt; Target speed</td>
<td>50%</td>
<td>65%</td>
<td>66%</td>
<td>58%</td>
</tr>
<tr>
<td>Interference</td>
<td>40%</td>
<td>24%</td>
<td>25%</td>
<td>32%</td>
</tr>
<tr>
<td>Kick Down override</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Driver's speed &gt; Target speed</td>
<td>4%</td>
<td>5%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Loss of target speed</td>
<td>0%</td>
<td>3%</td>
<td>1%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 5 - Overall driver use of the system, by type of road and for the total trip: Percentage of distance driven

Pre-evaluation analyses of the data collected have revealed the sizable influence of situational context (type of road, interaction with other drivers) on the acceptance of speed limitations and the tremendous
variability among drivers as regards system use (frequency of system interference, use of KD override) and impact on driver behavior (Table 5).

During the evaluation phase 15,911 routes have been travelled of average length 8.3 kilometers or about a total of 130,000 km. In the voluntary active mode, the driver overrides the system 6.8% of the time on average. Almost half (47%) of drivers override the system less than 1% of the time, while 5% were doing so over 30% of the time. Exercising the override option is far from being systematic. The reasons behind such discrepancies need to be determined from the driver's vantage point (tendency to raise driving speeds), with respect to the infrastructure (inadequate speed limits), or depending on specific traffic conditions.

The percentage of time KD is engaged among all test drivers varies from 0 to 29% depending on the individual driver. The average percentage amounts to 3.9% in the voluntary mode and 5.3% with mandatory use. The higher percentage found when driving in the mandatory mode may be explained in part by the unavailability of the override feature, which on average gets engaged 6.8% of the time. KD is not an actual override substitute since it does not provide for any override compensation. Instead, it tends to be complementary; its use arises under various conditions that still need to be identified.

The transition from neutral to advisory mode results in a reduction of 0.8 km/hr, or 7%, of the average level of speeding on test roads (Table 6). The transition from advisory to voluntary mode gives rise to a drop of 2 km/hr, i.e. 23%, in average motorist speeding, while the transition from neutral to mandatory accounts for a roughly 1.4 km/hr decrease in average speeding (13%). To help contain speed limit excess, the voluntary mode proves the most efficient. These average speed deviations are pushed higher by the road network with posted 50 km/hr limits, which represents the most travel time-intensive component for purposes of the present experiment. The speed limit-driven analysis provides greater insight; the highest reductions in speeding more often take place on the interurban and motorway networks.

<table>
<thead>
<tr>
<th>Speed limit</th>
<th>Without LAVIA</th>
<th>Advisory mode</th>
<th>Voluntary mode</th>
<th>Mandatory mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 km/hr</td>
<td>10.9</td>
<td>10.2</td>
<td>9.0</td>
<td>10.0</td>
</tr>
<tr>
<td>40 km/hr</td>
<td>10.8</td>
<td>10.3</td>
<td>9.3</td>
<td>10.0</td>
</tr>
<tr>
<td>45 km/hr</td>
<td>8.6</td>
<td>8.8</td>
<td>6.4</td>
<td>6.3</td>
</tr>
<tr>
<td>50 km/hr</td>
<td>11.3</td>
<td>10.7</td>
<td>8.8</td>
<td>9.5</td>
</tr>
<tr>
<td>60 km/hr</td>
<td>13.3</td>
<td>12.3</td>
<td>12.3</td>
<td>12.0</td>
</tr>
<tr>
<td>70 km/hr</td>
<td>11.1</td>
<td>10.1</td>
<td>9.3</td>
<td>10.6</td>
</tr>
<tr>
<td>80 km/hr</td>
<td>10.1</td>
<td>8.4</td>
<td>8.9</td>
<td>9.2</td>
</tr>
<tr>
<td>90 km/hr</td>
<td>10.6</td>
<td>8.7</td>
<td>8.3</td>
<td>8.4</td>
</tr>
<tr>
<td>110 km/hr</td>
<td>7.9</td>
<td>6.6</td>
<td>6.8</td>
<td>6.2</td>
</tr>
<tr>
<td>130 km/hr</td>
<td>6.7</td>
<td>6.8</td>
<td>3.8</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>10.8</td>
<td>10.0</td>
<td>8.8</td>
<td>9.4</td>
</tr>
</tbody>
</table>

**Table 6 - Speed limit excess, expressed in km/hr by both system mode and posted speed limit**

Let's now examine the temporal distributions of speed for itineraries when the posted speed limit lies above or at 30 km/hr: the posted speed is valid in this context (see Figure 2-a). The truncated distribution has been depicted on the left side from 10 km/hr to 80 km/hr so as to eliminate zero and very low speeds vs. the network speed limit.

The advisory system is more highly efficient for the network of roads limited to 90 km/hr, whereas it does not function on the network reaching posted speeds of 50 km/hr (Figure 2-b). On those networks limited to 50 km/hr and 90 km/hr, the effect of the two active modes (voluntary and mandatory) is similar. The speeds tend to compress around the speed limit with a clipping of the extremely high speeds (greater than 55 or 95 km/hr, respectively). Following this data-clipping operation, the only remaining speeds excesses are primarily those subsequent to a KD maneuver (Figure 6).
Based on these speeds distributions and the relationships that link speed to the accident probability and severity, it was possible to estimate the reduction rate of fatalities and serious injuries if 100% of the vehicles were equipped. Estimates were made for accidents involving vehicles in a frontal or side crash representing in France 40% of serious injuries and 50% fatalities. The results would be better if all types of accidents were taken into account. Then based on the distribution of fatalities and sever injuries by type of road, it is then possible to calculate the fatalities and serious injuries reduction (Table 7).

<table>
<thead>
<tr>
<th>LAVIA modes</th>
<th>Gain on fatalities</th>
<th>Gain on serious accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advisory</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Voluntary</td>
<td>250</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Mandatory</td>
<td>170</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Table 7 – Estimation of fatalities and serious accidents reduction per years

**Going forward**

Thus, if we look at the overall results from different countries other the world there are at least two common characteristics: a good level of acceptance for advisory systems, a high percentage of undecided drivers for active systems and last but not least significant speed reduction and safety benefits. Based on this finding, most actors (public authorities, OEM, equipment suppliers, research institutes) have recognized that to go towards the deployment, a purely advisory system would be a good compromise between acceptance and safety benefits. Therefore, the need to converge towards interoperable solutions and standards became quickly apparent. The major difficulty has emerged rapidly: how to build and to update the speed database taking into account the extreme variability existing from one country to another\(^2\)? To solve these problems several European projects have been conducted including SPEED ALERT, ACTMAP, MAPS&ADAS, FEEDMAP and finally ROSATTE.

SPEED ALERT (May 2004, April 2005) main objectives were [11]: 1) establish a common classification of speed limits in Europe relevant to in-vehicle speed alert applications, 2) identify the system and service requirements for in-vehicle speed alert applications, 3) define functional architecture and analyze the corresponding technical building blocks, 4) harmonize the definition of speed alert concepts and develop an associated deployment roadmap, 5) identify requirements for standardization, 6) develop cooperation and liaison with other activities on European/national level. An important outcome of Speed Alert is the definition of a functional architecture that has become a reference for projects that followed (Figure 3). The architecture is modular and designed to allow for a migration from first generations of autonomous systems, to future generations of systems interactive with road infrastructure and other relevant stakeholders:

\(^2\) For example in France, speed limits are set by municipalities that mean over 36,000 decision locations.
1. Data Collection, Generation & Update: As owners of speed limit data, public authorities are responsible for its procurement and continuous update.3

2. Data Processing: Integration of speed limit data from different sources involving map makers (static speed limit and incremental updates), traffic control centers (variable speed limit) and service providers (variable speed limit and incremental updates).

3. Communication Infrastructure: Communication channels for the provision of variable speed limits and update of static speed limits operated by service providers (broadcast/cellular) and road operators (short-range communication)

4. Communication Interfaces: In-vehicle interfaces for broadcast, cellular or short range communication developed by system suppliers and car manufacturers.

5. Speed alert Applications: Applications developed by system suppliers and vehicle makers making use of speed limit information. In-vehicle speed limit information is beneficial for multi-use purposes including enhanced navigation and ADAS(Advanced Driver Assistance Systems) applications.

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**MAPS&ADAS (2004-2007)** is a subproject of the PREVENT European IP project. Within the PREVENT Integrated Project, the three-year MAPS&ADAS cross-functional subproject is developing, testing and validating appropriate methods in gathering, certifying and maintaining ADAS attributes to enable the provision of ADAS maps as well as a standardized interface between ADAS applications and ADAS map data sources for accessing map data regarding vehicle position. In this project digital map is considered as a predictive sensor that extends driver horizon and in-vehicle sensors range. Target applications are not limited to ISA but also include enhanced navigation, lane keeping assistance, lane departure warning, curve warning, intersection assistance, enhanced navigation, vulnerable road users, accident hot spot warning, curve warning, fuel economy and roll-over warning. An important concept of Maps&Adas is the electronic horizon [14] which describes the road segments ahead of the vehicle with available attributes. It helps to anticipate the itinerary difficulties and provides information to ADAS.

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3 This is the idealized Speed Alert vision. In practice, the role of public authorities varies widely by country.
**Figure 4 – Electronic Horizon**

ROSATTE [12] is an ongoing project that aims to establish an efficient and quality ensured data supply chain from public authorities to commercial map providers with regards to safety related road content. Figure 5 illustrates that the focus of the project is to establish an infrastructure for transmitting road safety attributes in a reliable and quality assured way, from road authorities, via a suitable exchange infrastructure, to information providers. These road safety attributes will be processed further into suitable services to the end user. However, this processing is not within the scope of the ROSATTE project as the grey area illustrates.

**Figure 5 – ROSATTE Scope**

Even if the project is not yet completed, we can already highlight some important results:

- A definition of relevant stakeholders and roles, and the connection between them: enacting authority, data store operator, information provider, data provider, data service operator, discovery service operator, subscription service operator,
- A definition of requirement from road authorities and map provider point of view,
- An UML representation of uses cases grouped in three categories and their underlying process: maintain attributes, exchange attributes and integrate attributes,
- An UML representation of a conceptual data model
- Recommendation for referencing road attributes (Agora-C and ISO 17572) and defining road geometry (ISO19100)
French Initiatives: BALI and COSAL

Launched by the French Ministry for Transportation, the BALI project is a feasibility study to build and update a speed limit database which covers the whole county of Yvelines near Paris. Project management and monitoring is entrusted to SETRA – Road, transport and safety department (CSTR). The western Paris regional transport research laboratory (LROP) ensures overall project (Figure 6). Objectives are both organizational and technical, namely: 1) To analyze both technical and operational terms and conditions for setting up (initialization and updating) a national speed limit database and estimating financial investment and subsequent management costs., 2) To implement a demonstration on a single pilot county scale foreshadowing management of a future national database, to allow cost evaluation as well as partners' interest validation (service providers, local authorities, mapmakers, etc.).

The BALI database was initialized thanks to the following process:

- Data from municipalities: in order to involve the different municipalities from an early stage of the project a process based on paper maps has been defined. LROP produced blank maps with the road network of each municipality. These latter had to fill in them with colored sections delineating the different speed limit sections, as they are known from them. These maps were then digitized into the BALI database using the BALI interface. About 60% of speed data was provided by the municipalities.

- Major roads and remaining data from municipalities: the 40% remaining speed data and the major roads has directly been being surveyed on the field by LROP's operators. Dedicated software using an embedded GPS and an odometer was realized to equip a car. Through a very simple and intuitive interface data was collected on two thirds of this network during four weeks (around 1000 km road in one direction then the other).

A first version of the BALI speed limits database is available since September 2009 [18].

As an extension of the LAVIA and BALI projects (Figure 7), the COSAL experimental initiative consists in implementing and evaluating some solutions to convey the BALI database information as well as additional temporary and dynamical speed limits into the vehicle.
The project is widely using the outcomes of the Speed Alert project as well as those of ongoing projects like ROSATTE [15], CVIS [16], SAFESPOT [17]. The project has then two objectives: 1) to identify, implement and evaluate a functional and technical architecture to convey the mandatory speed limits (static, temporary and dynamic) to an onboard platform executing a Speed Alert application, 2) to identify, implement and evaluate some mechanisms and services for the Speed Alert system to have access to updated and relevant information. The adopted solutions must be as generic/standard as possible to enable a pan-European deployment. Moreover an additional objective of the COSAL initiative is to set-up a kind of “showcase” to convince public authorities and the various operators involved in the value chain, whether public or private.

Depending on the kind of speed limits (static, dynamic, temporary) and drivers (static, nomad or moving), different updating mechanism considered: 1) synchronization: full downloading of both the speed alert application and the required data, namely the digital map and the static and known temporary speed limits, 2) Infouelling: downloading of the data required by the speed alert system for a given area (huge set of road links), namely the related digital map and the static and known temporary speed limits, 3) Updating service subscription: Really Simple Syndication (RSS) of the static, temporary speed limits as well as dynamic ones (if exist) for a narrow area (narrow set of road links), 4) updating event broadcasting: broadcasting of the speed limits for a local area (small set of road links) whether static, temporary or dynamic - with management of compatibility with existing on-board database (digital map).

The COSAL architecture (Figure 8) is a subset of Speed Alert architecture. The speed data from different sources are centralized in the BALI server as above mentioned. BALI server is deemed to provide an updated database and therefore constitute the baseline. BALI export format is the generic 17572 ISO reference [19]. Conversely, the COSAL database is the archetype of what will be produced by a service provider. It contains the same speed limitation information than in the BALI database but differs from the latter by format representation. This format named PSF is compatible with its usage, in our case, the Speed Alert application to be executed on an onboard PC or PDA. The format adaptation is performed by COSAL server. Actually MID-MIF (Mapinfo Interchange Format) was selected as PSF. To optimize the updating process the BALI speed database has been cut in tiles. Each tile covers an area of about 100x100 meters. The tile is the smallest amount of information that can be downloaded from the vehicle during an update. Finally, web services between vehicles and COSAL server allow incremental updating with different processes depending on the destination of the driver is known or not (Figure 9).
COSAL demonstrator has been implemented during the second quarter 2009 on LIVIC test tracks. Its extension to the whole area covered by BALI (Yvelines County) is underway.

Towards the deployment: obstacles and stimulation\(^4\).

The European state of art drawn above shows that ISA stakeholders have the knowledge and the building blocks to go towards deployment: acceptance and effectiveness has been demonstrated, organizational models for data collection exist, technological solutions to update data in the vehicle are known. However, up to now, the ISA is still not widely deployed. What are the obstacles and what could be incentives to push toward deployment?

The most significant obstacle is the lack of economic model and probably depending on country an insufficient involvement of States. Indeed, behind the functional architecture of ISA, there is a value chain (Figure 10) and behind this value chain there are stakeholders.

\[\text{Figure 10 – ISA value chain}\]

- Data collection for database initialization: supported today mainly by private map makers (in France) or motorways operators, but for main road only (highway and motorway). The BALI organizational model seems not easy to spread throughout the country without incentives.
- Data collection for updating: should necessarily involve the local authorities because it is impossible for the map makers to scan periodically throughout the road network. Clearly, municipalities are in good position to provide information about speed data changes. Then a public or private operator could conduct a survey on field on indicated locations.
- Data integration: includes the conversion in a proprietary format (PSF), merging with other information (comfort or entertainment) and provision for services based on the data. Supported by private operator
- Web services: includes data tiling, web services for database synchronization and updating, RSS flow. Supported by private operator.
- Telecom: concerns telecommunication based on infrastructure network e.g. 2, 2.5 or 3G and communication between vehicles and road side unit for dynamic speed limits. Supported by telecom and road operators.
- In vehicle platform: could be a nomadic system or an embedded system including speed database, speed alert application, GPS, telecommunication receiver/transceiver. Supported by equipment suppliers or OEMs.

Operating this value chain has a cost that cannot be supported by the driver only. Obviously this cost will be borne by different contributions: the price that the user is willing to pay, subsidies from states, indirect incentives, sharing with other services (e.g. mobility and comfort services).

To our knowledge no comprehensive study on willingness to pay has been conducted in France. Indeed the discussions that we may have with individual drivers suggest that they are willing to invest an amount corresponding to the first offense avoided (from 68 € to 375 € depending on speeding and late payment).

On the other hand, equipment suppliers tell that it is difficult to sell a handheld device that exceeds, in 2009, a sum within the range 80-100 € if they are dedicated to only speed warning. This is confirmed by the price of systems already on sale on the market which is roughly at that level (Table 8).

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\(^4\) This section is not intended to represent an official position of the French public authorities and commits its author only.
Name | Product | Purchase price | Subscription price
--- | --- | --- | ---
INFORAD | Nomadic Speed radar warning | 70 € (incl. lifetime database) | Not applicable
COYOTE | Speed radar warning | 179 € (incl. 3 years update) | 12 €/month
COYOTE Classic | Speed radar, speed limits warning, traffic information | 209 € (incl. 3 month update) | 35 €/month
NAVX | Speed radar “plug-in” for PDA, Smartphone, navigation system | Not applicable | 30 €/year
IGN Evadeo Ushaia | Navigation, speed radar, speed limits | 250 € | 18 €/year

Table 8 – Price of some products on the market

Concerning State support the current economic climate is not favorable to a commitment by States. However, in France it is expected that benefits from automated speed radar have to be reinvested in road safety. These benefits could be partly used to fund the ISA value chain at least in a transitional phase.

Incentives can be directed towards the driver but also road managers or municipalities. On the one hand, insurance companies could make a reduction in insurance premiums for drivers who equip their vehicle with an ISA. On the other hand, to encourage municipalities to update their speed database, distinctions similar to EuroNcap may be awarded to most active municipalities and ranking could be established. We have seen in the past how the EuroNcap pushed car manufacturers to make progress in passive safety.

Finally, we must share the infrastructure costs across several services to minimize the price paid for ISA. For example, costs for servers, web services and telecommunications networks can be shared between security, mobility or comfort services.

It remains to mention the role of the user community. Several road information systems based on this community are already on the market. We can mention the COYOTE [22] system that warns of the presence of speed radar and is updated thanks to inputs provided by users. Could they contribute to the ISA? It depends on the legal status of system. If the ISA is a simple help that does not commit the responsibility of the service provider, then the answer is yes. Conversely, if the system controls vehicle actuators (speed limiter) then the data provider must guarantee a quality of service that system based on community cannot provide. However the role of the community would be very useful to notify the service provider the differences between the reality and the database. The operator can then proceed to field survey applying the highest standards of quality.

References

5 Mean rates (in 2009) provided for information only, actual rates are depending on vendors.


[16] CVIS European project website: www.cvisproject.org


[18] BALI website :


