

Speed management through vehicle measures, Intelligent Transport Systems and Intelligent Speed Assistance

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What is ITS?

- **Intelligent Transportation System (ITS)** refers to :
 - efforts to add **information and communications technology** to transport infrastructure and vehicles
 - in an effort to manage factors that typically are at odds with each other, such as vehicles, loads, and routes
 - to **improve safety and reduce vehicle wear, transportation times, and fuel consumption.**

Different types of ITS



What are ADAS?

- We will focus on **Advanced Driving Assisting Systems (ADAS)**
 - **ADAS** are systems to help the driver in its driver process. When designed with a safe Human-Machine Interface it should increase car safety and more generally road safety.

Types of ADAS:

- In-vehicle navigation system with typically GPS and
- TMC for providing up-to-date traffic information.
- Adaptive cruise control (ACC)
- Lane/road departure detection/warning system
- Lane departure warning
- Lane change assistance
- Collision warning system
- **Intelligent speed adaptation or intelligent speed advice (ISA)**
- Night vision
- Adaptive light control
- Pedestrian protection system
- Automatic parking
- Traffic sign recognition
- Blind spot detection
- Driver drowsiness detection
- Car2car communication
- Hill descent control

What is ISA?

Intelligent Speed Adaptation are intelligent in-vehicle transport systems, that can

- warn the driver about speeding,
- discourage the driver from speeding or
- prevent the driver from exceeding the speed limit



Different systems

Level of support	Type of the feedback	
Informing	Mostly visual	The speed limit is displayed and the driver is reminded of changes in the speed limit.
Warning (open)	Visual/auditory	The system warns the driver if he is exceeding the posted speed limit at a given location. The driver himself decides whether to use or ignore this information and to adjust his speed.
Intervening (half-open)	Haptic throttle (moderate/low force feedback)	The driver gets a force feedback through the gas pedal if he tries to exceed the speed limit. If applying sufficient force, it is possible to driver faster than the limit.
Automatic control i.e speed limiter (closed)	Haptic throttle (strong force feedback) and Dead throttle	The maximum speed of the vehicle is automatically limited to the speed limit in force. Driver's request for speeds beyond the speed limit is simply ignored.

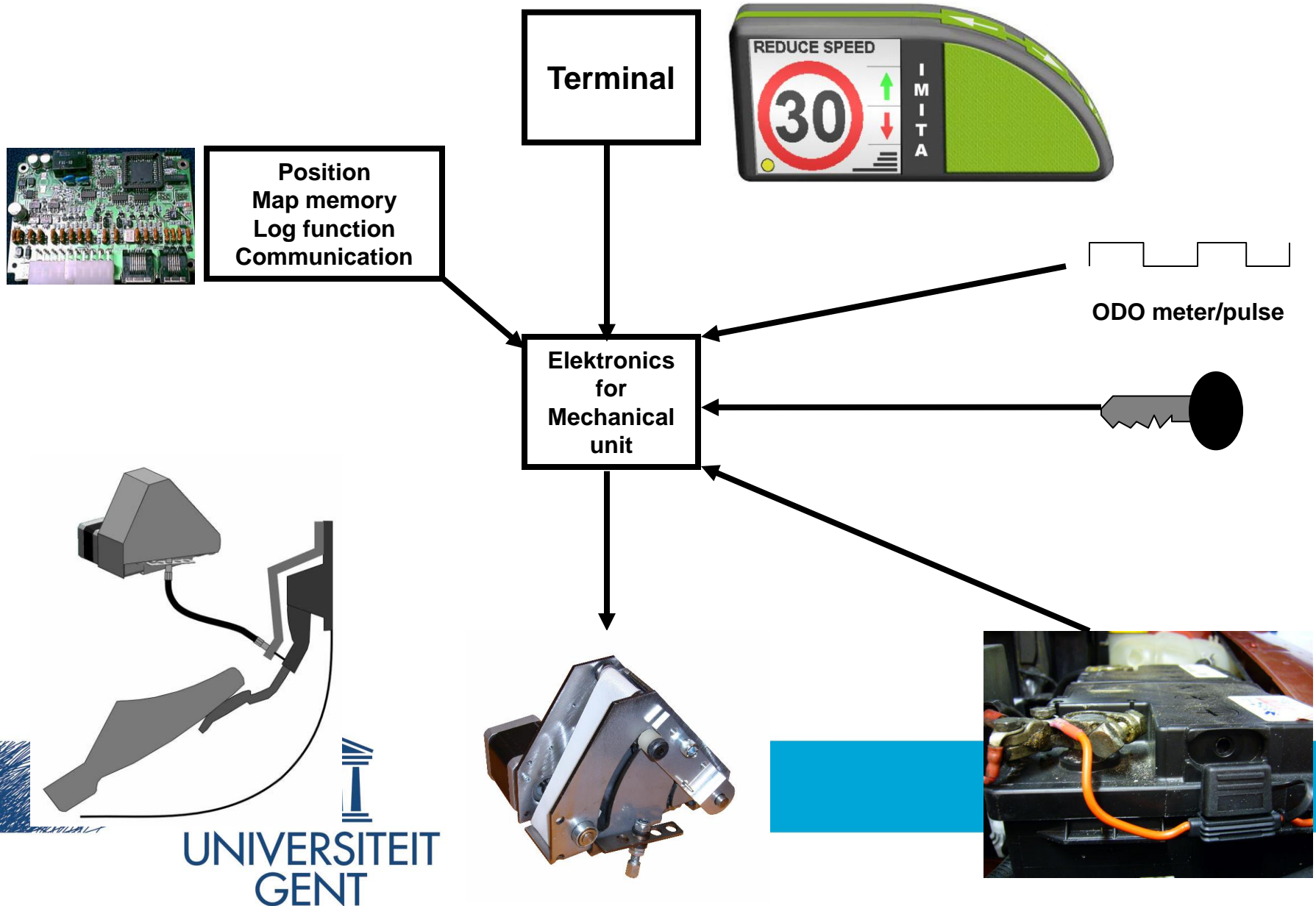
Source: Morsink et al. 2006, SWOV

How does ISA work?

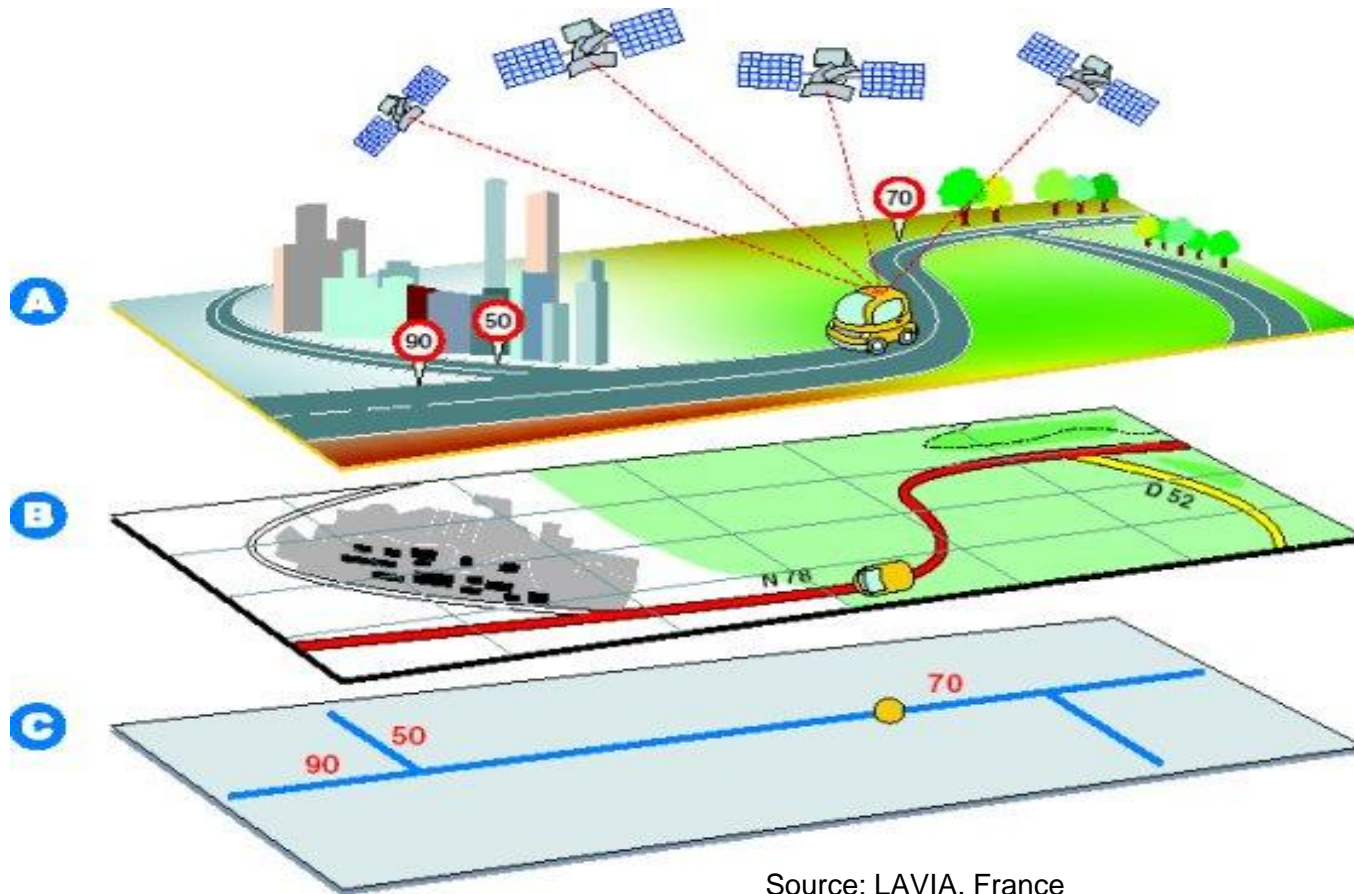


Source: e-safety/e-prevent

SMART GAS PEDAL™



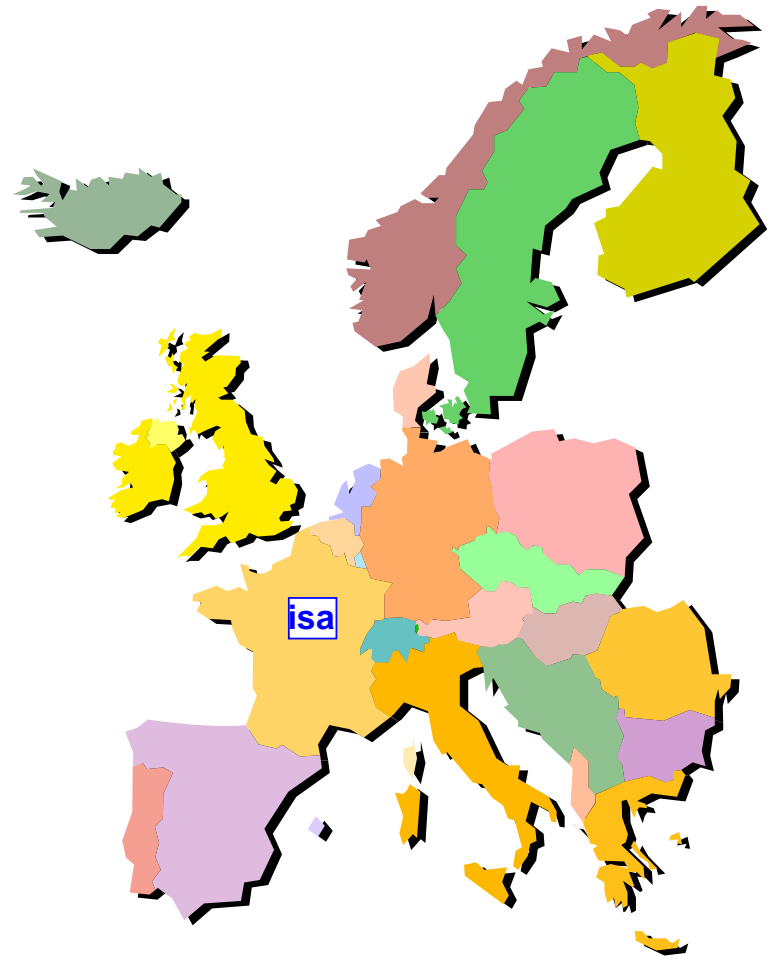
How does ISA work?



Source: LAVIA, France

ISA – History

- The pioneers: Saad and Malaterre, 1982

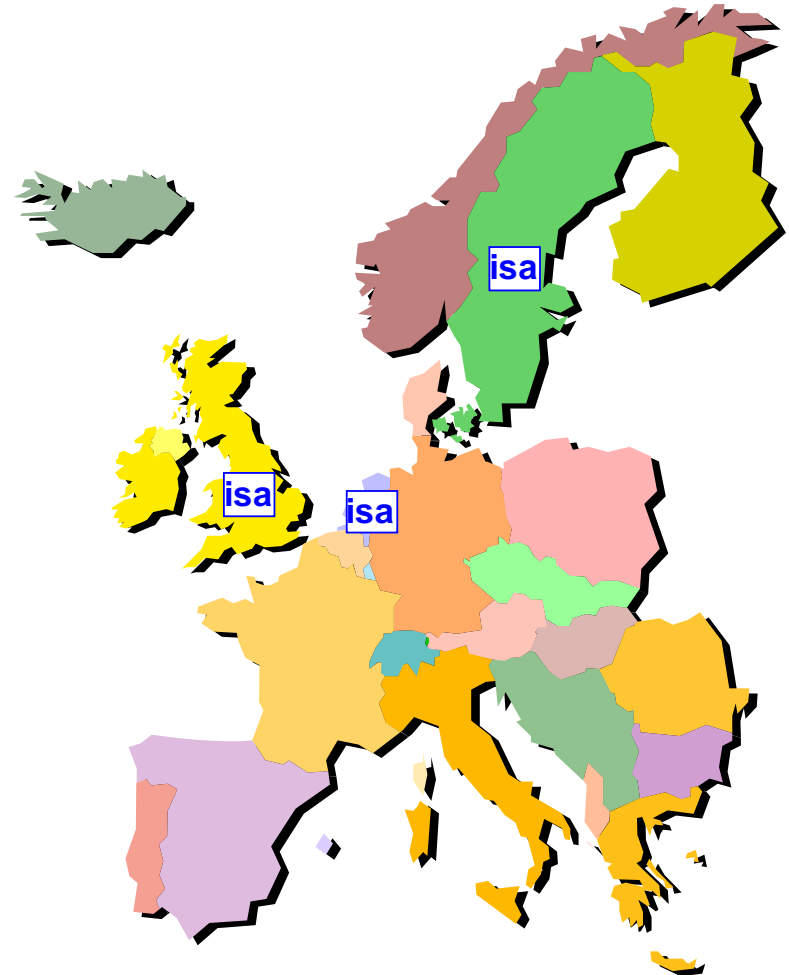


Source: Oliver Carsten, University of Leeds

ISA – History

1990s

- Trials in Sweden, culminating in the large-scale trial of 1999-2001
- EVSC project in Britain, 1997-2000
- Tilburg in the Netherlands: 20 cars used by 120 drivers (1999-2000)

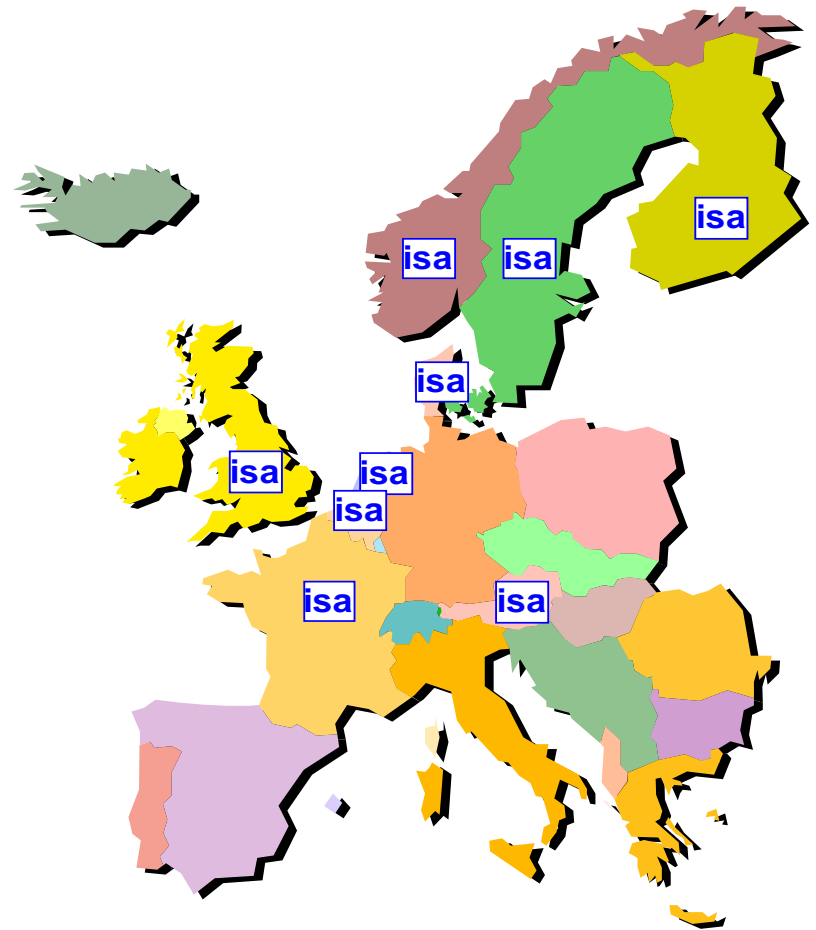


Source: Oliver Carsten, University of Leeds

ISA – History

2000 and later

- Denmark (2000-1 and 2005-8)
- Finland (2001-)
- ISA-UK (2001-6)
- Two projects in Belgium (2001-2)
- LAVIA in France (2002-6)
- Austria (2003-4)
- Norway (2005-)
- +
- Australia (TAC SafeCar)
- Japan (Soft Car)



Source: Oliver Carsten, University of Leeds

Examples of trials

Sweden

- In the cities of Umea, Borlange, Lund and Linköping approximately 5000 thousands vehicles had been equipped with:
- two types of warning ISA (Umea, Borlange)
- an intervening ISA (Lund).
- In Linköping, both informative and accelerator pedal systems were tested

Test site (type of ISA and road types)	ISA effect on speed limit violations		
	% of vehicle kilometres travelled above speed limit, Pre-period	Change % of vehicle kilometres travelled above speed limit, Post-period 1	Change in % of vehicle kilometres travelled above speed limit, Post-period 2
Lund – intervening ISA			
30 km/h	33.7	-14.1	-6.9
50 km/h	28.2	-15.0	-12.8
70 km/h	35.9	-18.1	-13.6
Borlange – warning ISA			
30 km/h	33.8	-9.6	-3.4
50 km/h	31.1	-16.4	-11.8
70 km/h	21.4	-13.0	-9.4
90 km/h	25.1	-16.7	-11.4
110 km/h	12.4	-9.5	-7.4

Source: SRA, 2002

Examples of trials

France

- A trial near Paris was held with the cooperation of car-manufactures
- three modes of ISA - advisory mode, voluntary active mode and mandatory active mode – were used
- Results of the pre-evaluation:

	Urban roads	Country roads	Motorway	Journey
Speed driven \leq regulatory speed limit	74%	86%	93%	81%
Speed driven $>$ regulatory speed limit	26%	14%	7%	19%
Total	100%	100%	100%	100%

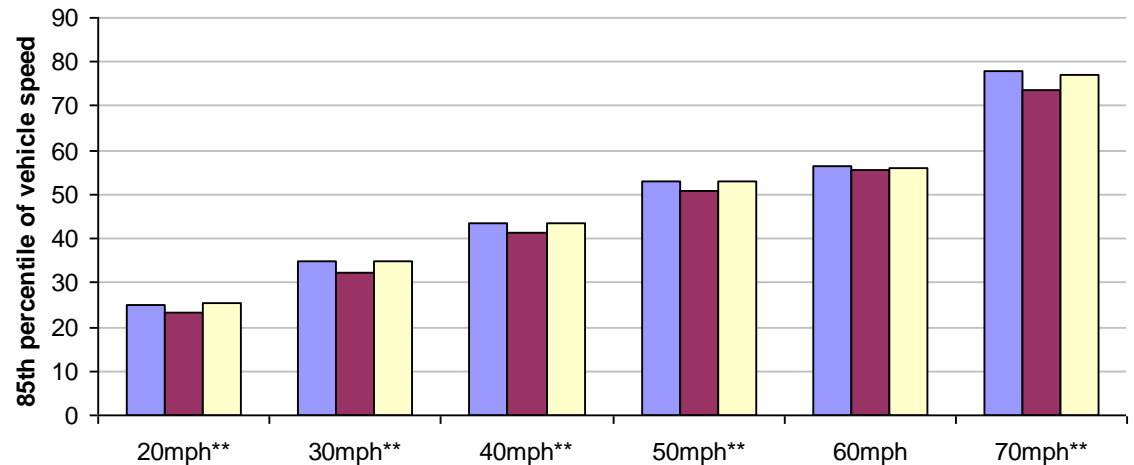
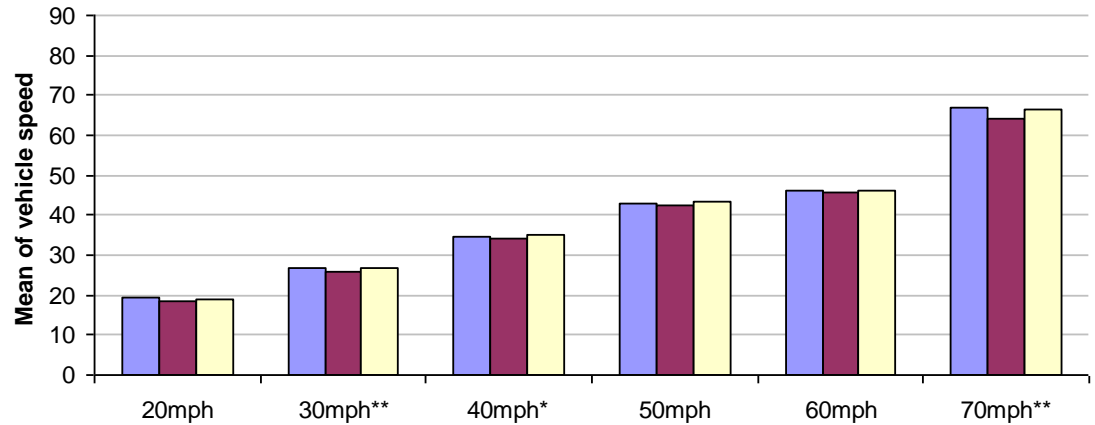
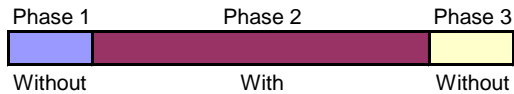
Table 3. Distance driven at a speed lower than, equal to or higher than the speed limit, according to the type of road and the length of the journey (in %).

Source: Saad et al., 2007

Examples of trials

UK

2 urban trials in Leeds (1 private motorists, 1 fleet) and 2 rural trials in Leicestershire (1 private motorists, 1 fleet)



Examples of trials

Belgium

- Trial in Ghent with Active Accelerator Pedal.
- Some drivers were used as role-models in ISA-driving

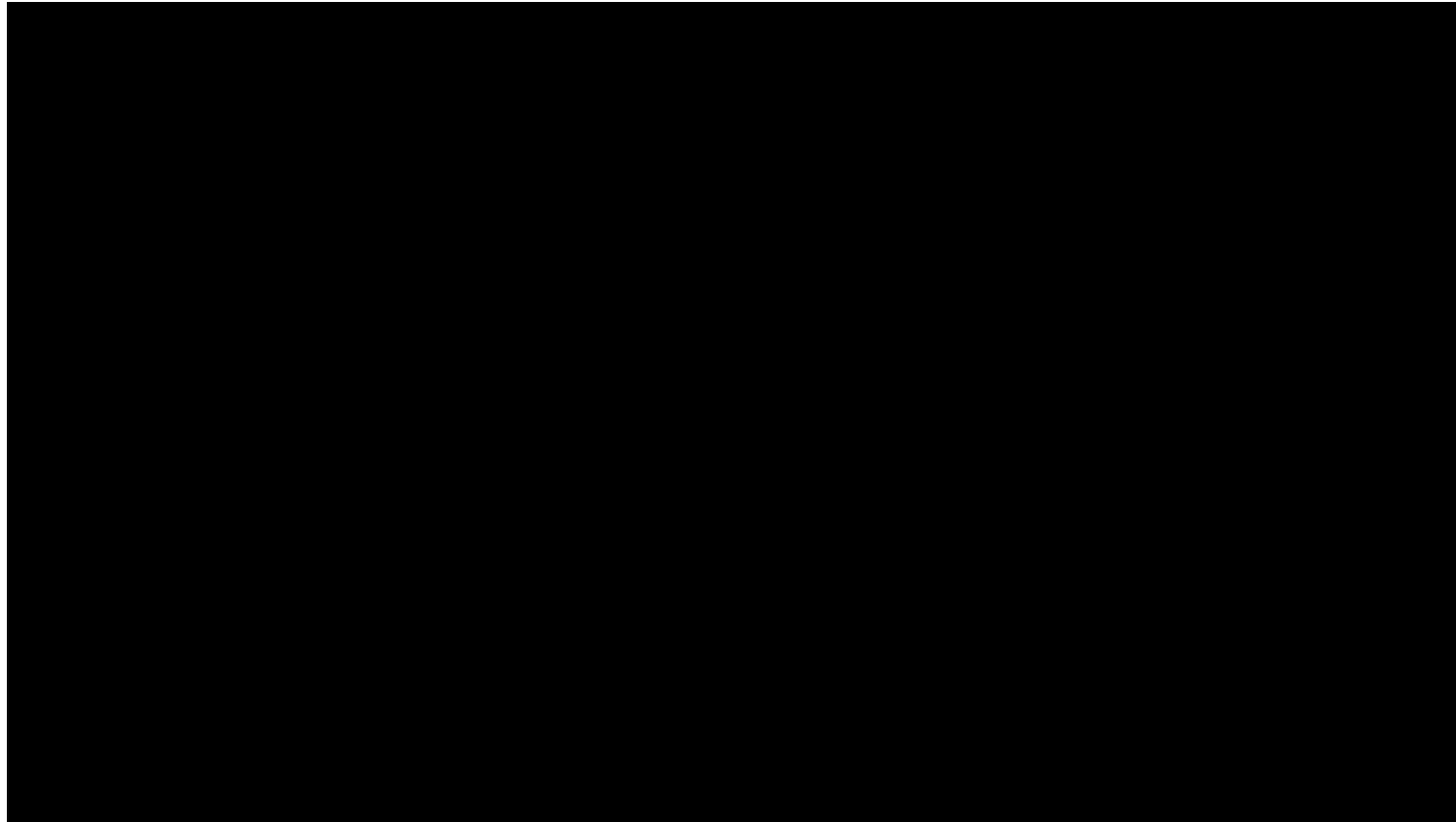
Speed limit (km/h)	AAP inactive (%)	AAP active (%)
30	45.90	42.80
50	14.70	13.10
70	17.60	12.60
90	13.50	3.80
Total	16.30	13.10

Table 2.17. *Percentage of driven distance while speeding, in the test area*

Examples of trials

Denmark

- Trial with young drivers and “pay as you speed system”



Examples of trials

The Netherlands

- A trial with a closed system
- 120 test drivers drove an equipped vehicle, each for 8 weeks.

Speed limit (km/h)	Average speed when driving without ISA (km/h)	Average speed when driving with ISA (km/h)	Difference (km/h)
30	28.9	25.1	-3.8
50	40,0	38.2	-1.8
80	57.3	57.0	-0.3

Effects of ISA

- General findings regarding ISA speed effects based on some trials and simulator studies

Study	Methodology	Country	Effect on mean speed	Effect on standard deviation of speed	Speed violations
Comte (2000)	Driving simulator	UK	↓	↓	?
Peltola & Kumala (2000)	Driving simulator	FIN	↑	↓	?
Hogema & Rook (2004)	Driving simulator	NL	↓	↓	↓
Van Nes et al. (2006)	Driving simulator	NL	↓	↓	↓
Brookhuis & De Waard (1999)	Instrumented vehicle	NL	↓	↓	↓
Paatalo et al. (2001)	Instrumented vehicle	FIN	↓	?	↓
VVN (2006)	Instrumented vehicle	NL	?	?	↓
AVV (2001)	Field trial	NL	↓	↓	?
Lahrman et al. (2001)	Field trial	DK	↓	?	?
Biding & Lind (2002)	Field trial	S	↓	↓	↓
Vlassenroot et al. (2007)	Field trial	B	↓	↓	↓

Source: Morsink et al.

Effects of ISA

- ISA effects on safety

System type	Speed limit type	Best estimate of injury crash reduction	Best estimate of fatal and serious crash reduction	Best estimate of fatal crash reduction
Informing	Static	10%	14%	18%
	Variable	10%	14%	19%
	Dynamic	13%	18%	24%
Voluntary automatic control	Static	10%	15%	19%
	Variable	11%	16%	20%
	Dynamic	18%	26%	32%
Mandatory automatic control	Static	20%	29%	37%
	Variable	22%	31%	39%
	Dynamic	36%	48%	59%

Best estimates of crash savings by ISA type and crash severity (source: Carsten & Tate, 2005)

Effects of ISA

- **ISA effects on the environment**
 - have positive effect on reduction of emissions
- **ISA effects on traffic efficiency**
 - homogeneous traffic flow on traffic throughput predominantly show positive results
- **ISA side effects**

Estimated effects of ISA on safety, environment, efficiency

	Type of system		
	Informing (static)	Warning Intervening (static)	Controlling Limiting (dynamic)
Fatal crashes	≈ -20 %		≈ -50%
CO ₂		-2 to -11 %	
NO _x		-2 to -7 %	
HC		-2 to -8 %	
Travel time	- to 0 (high traffic density)		
	0 to + (low traffic density)		

Users' acceptance

- **Acceptance versus effectiveness paradox**
 - *the more effective the system is, the less accepted it will be*
- **The driver**
 - Drivers, whose speed behaviour would benefit most from ISA, are accepting ISA the least.
 - Driver characteristics could especially be significant for the acceptance and furthermore for the real use of voluntary types of ISA
- **The road environment**
 - Credible speed limits

Implementation of ISA

Implementation strategies

- **Mainly market-driven – private cars**
 - Informative/warning ISA
 - Combination of functions (e.g. ISA+navigation+ACC)
 - Purchase motivation: less fines, more comfort, safety and environmental awareness, enriched traffic information
- **Mainly market-driven – professional fleet**
 - Economical advantage
 - Fitting in a company's 'safety culture'
- **Mainly government-driven**
 - Automatic controlling/limiting ISA
 - Create acceptance
 - Focus on high-risk groups (?)

Implementation of ISA

Crashes Saved 2010 to 2070

	Slight Crashes	Serious Crashes	Fatal Crashes
Market Driven	4%	8%	13%
Authority Driven	15%	25%	30%

- Benefit to cost ratios (accidents + fuel + CO₂):
 - Market Driven scenario 3.4
 - Authority Driven scenario 7.4

Source: Oliver Carsten, University of Leeds

Initiatives

- There are implementation initiatives in
 - London (Company-cars)
 - Stockholm
 - Gothenburg
- ISA or speed alert products can be found on navigation systems (Tomtom)
- ISA in the form of a camera-based system:
 - Opel
 - Saab
 - Mercedes-Benz
- Initiatives in creation of speed limit databases

Speed limit databases

- **Speed Alert project**

Research on framework to harmonize the in-vehicle speed alert concept definition and to investigate the first priority issues to be addressed at the European level.

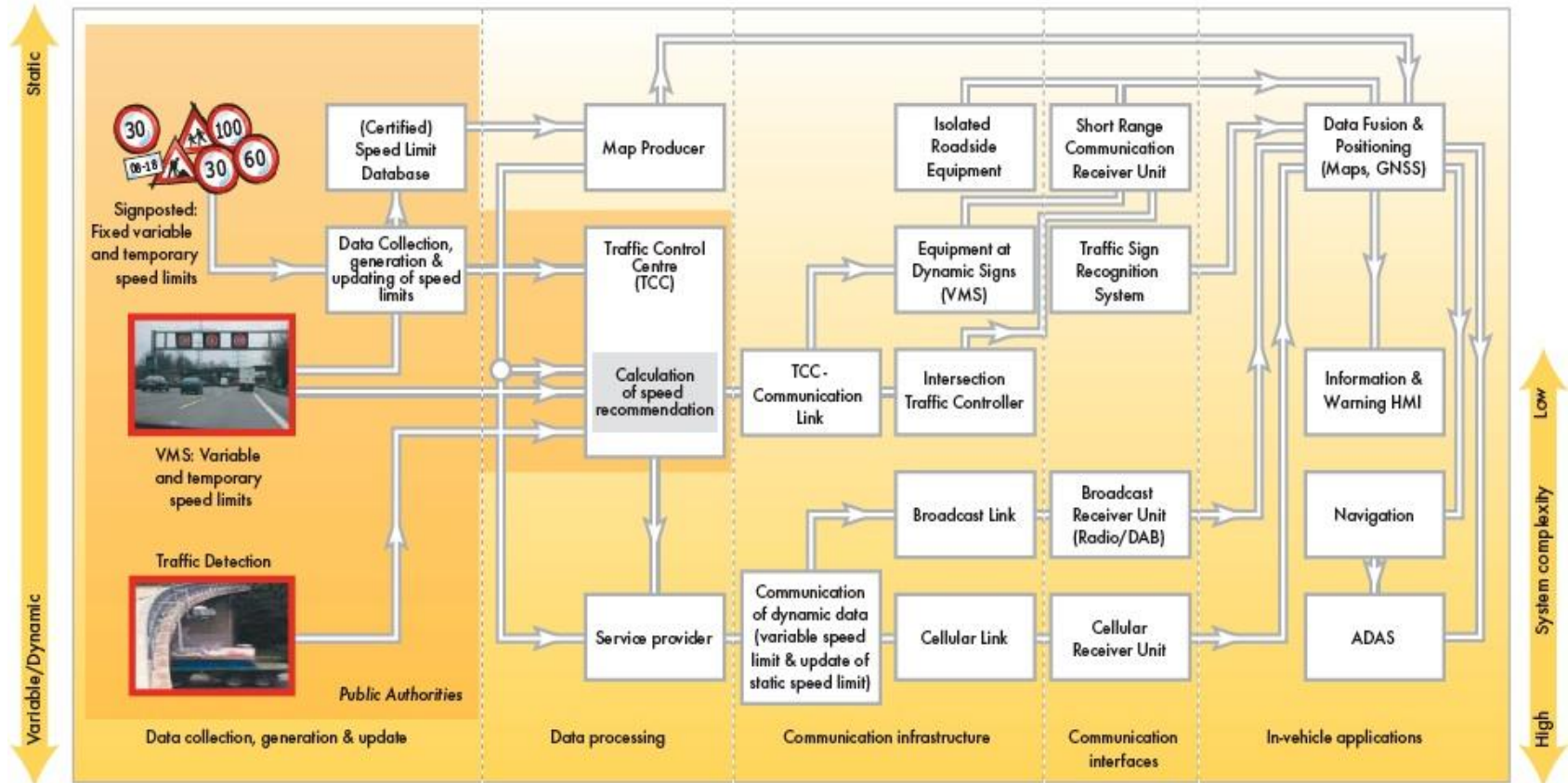
- **ActMAP**

online incremental updates of digital map databases in the vehicle was investigated and created.

- **Others:** MAPS & ADAS, Feedmap,.....

- **National Road Databases:** Finland, Sweden, Flanders, France,...

Speed limit databases framework



conclusions

- ISA has a long history (already 20 years)
- ISA is beneficial in road safety and livability
- Small steps in implementation are made (city initiatives, speed limit databases)
- EU directive about speed limit databases
- Still the question: Why take it so slow to implement?

- Questions?

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More info on <http://www.isaweb.eu>