Active Safety and Cooperative Systems in the Road Infrastructure of the Future

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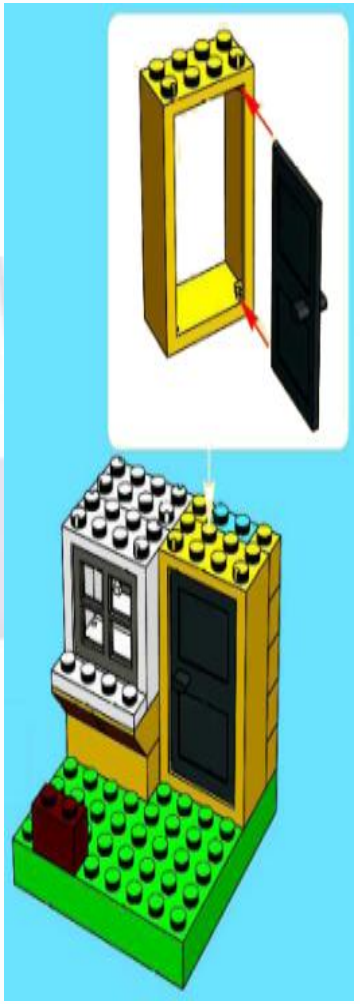
Traffic Safety: Putting the legos in place

- Traffic safety risk emanates from the cooperation of three main factors: driver-vehicle-traffic environment.
- Measures in order to support/improve any of these factors, may have negative side-effects to the others.
- According to the risk homeostasis theory (Wilde 2001), the enhancement of safety level of a vehicle leads sometimes drivers to change their driving profile, undertaking more risky maneuvers, in order to keep their conceived level of risk constant.
- Thus, optimal measures to improve to all three contributors or build upon the strengths and interactions between each combined environment.
- Alternatives for the safety hazards, can be based upon Autonomous (e.g. only Infrastructure or in-vehicle based) or Co-operative solutions (e.g. V2V, I2V, or/and In-Vehicle ones).



The two pillars of Road Safety and Infrastructure:

I. Forgiving Roads

A forgiving road is defined as a road that is designed and built in such a way as to interfere with or block the development of driving errors and to avoid or mitigate negative consequences of driving errors, allowing the driver to regain control and either stop or return to the travel lane without injury or damage.

II. Self-explanatory Roads

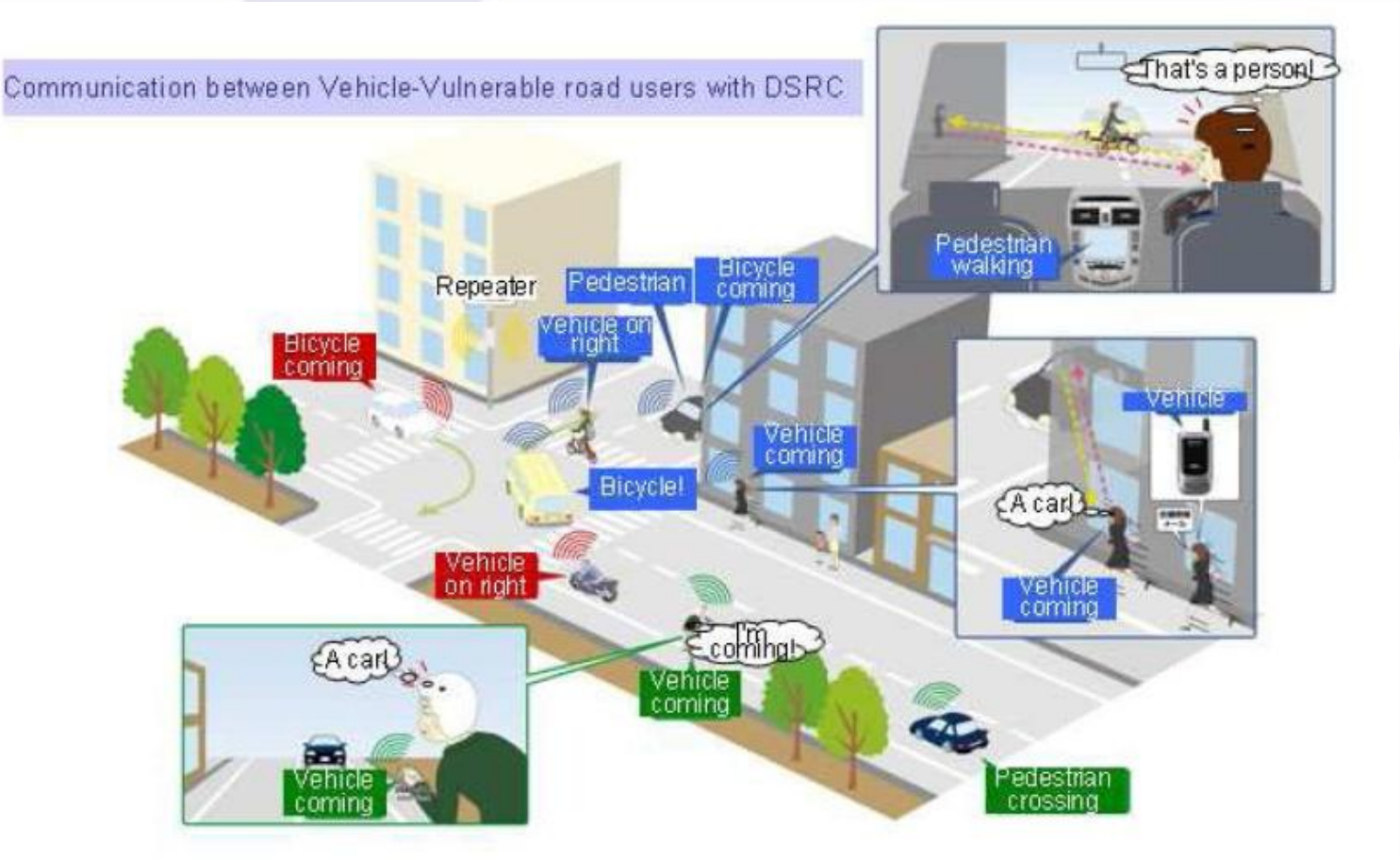
Self-explanatory road is defined as one that is designed and constructed to evoke correct expectations from road users and elicit proper driving behaviour, thereby reducing the probability of driver errors and enhancing driving comfort.

High-Speed Through Roads (Pictures courtesy of CROW, BASt)

We are living in a cooperative world…

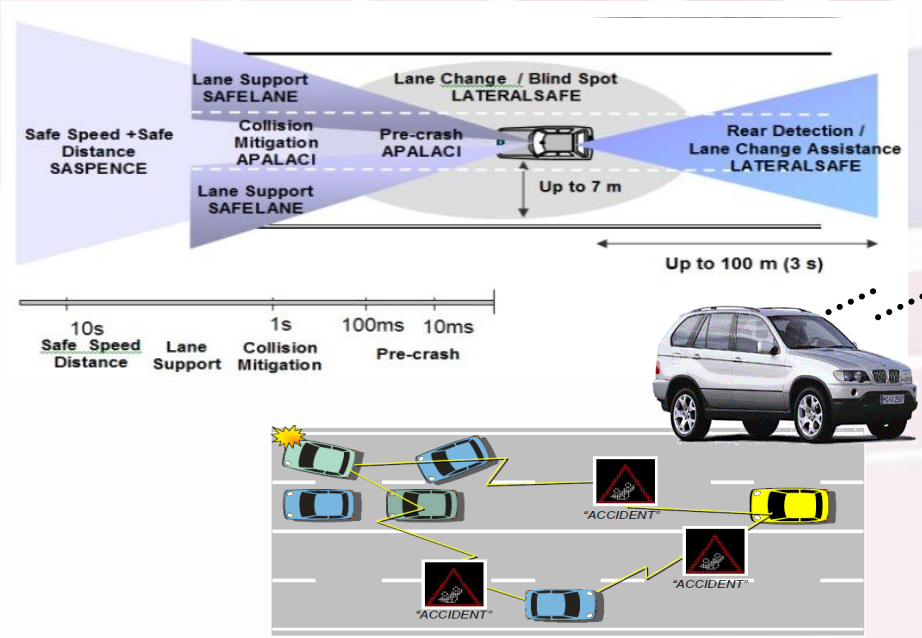
This is true when we are on the road too…

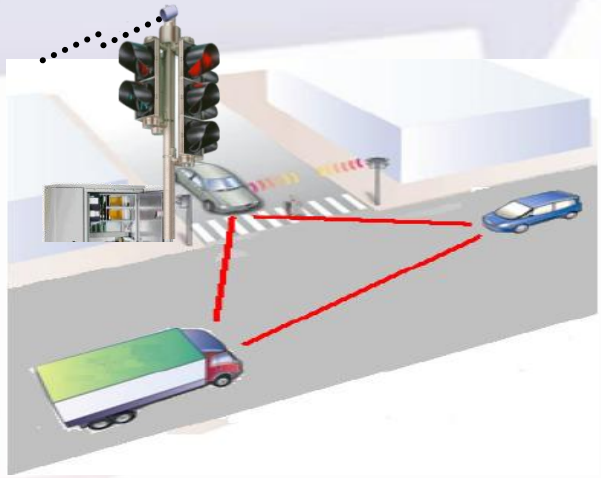
VRU Detection systems



Cooperative Systems (indicative)

- Speed adaptation (V2I and I2Vcommunication)
- Reversible lanes due to traffic flow (V2I and I2V)
- Local danger / hazard warning (V2V)
- Post crash warning (V2V)
- Cooperative intersection collision warning (V2V and V2I)





Cooperative Systems – Potential Impacts

- According to CODIA Final Report, Cooperative systems showed high potential to contribute to improved traffic safety (Kulmala, 2008).
- Dynamic speed adaptation showed most potential (-7%) to decrease fatalities.
- The cooperative intersection collision warning and local danger warning comes next (-4%).
- The potential of injury prevention is higher for cooperative inter-section collision (-7%) followed by dynamic speed adaptation (-5%).
- The reversible lane system decreases the fatalities and injuries on the sections equipped. However, a very small part of the motorway and urban network are suitable for the system.
- The SAFESPOT impact analysis study showed considerable safety effects resulting in 7.1 % less fatalities for the V2V case, and 8.9 % for the V2I case, assuming a 100 % penetration rate of cooperative systems into the vehicle fleet (Schindhelm, 2010).

Some ideas…

1. Virtual Rumble Strip

- Vehicle lateral and rear monitoring system (LRM)



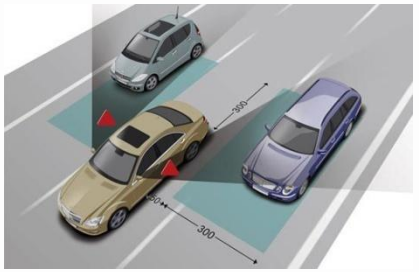
- Lane Departure Warning / Lane keeping Systems (LDWS)



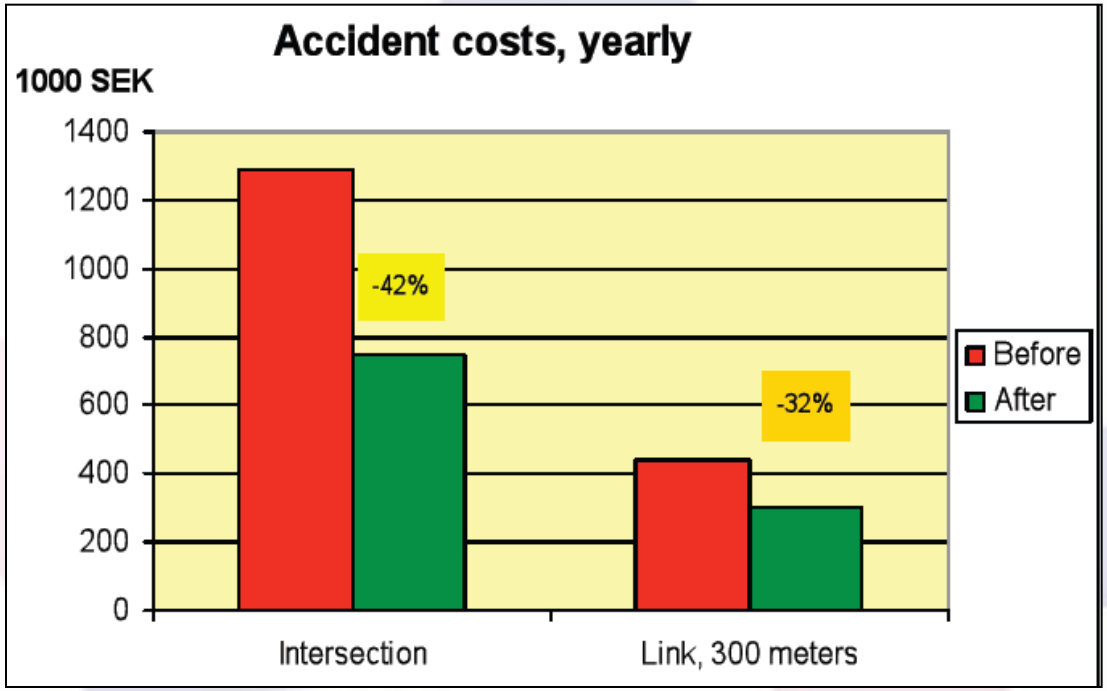
- Collision Avoidance Systems (CAS), for the lateral area, including lane change support systems.







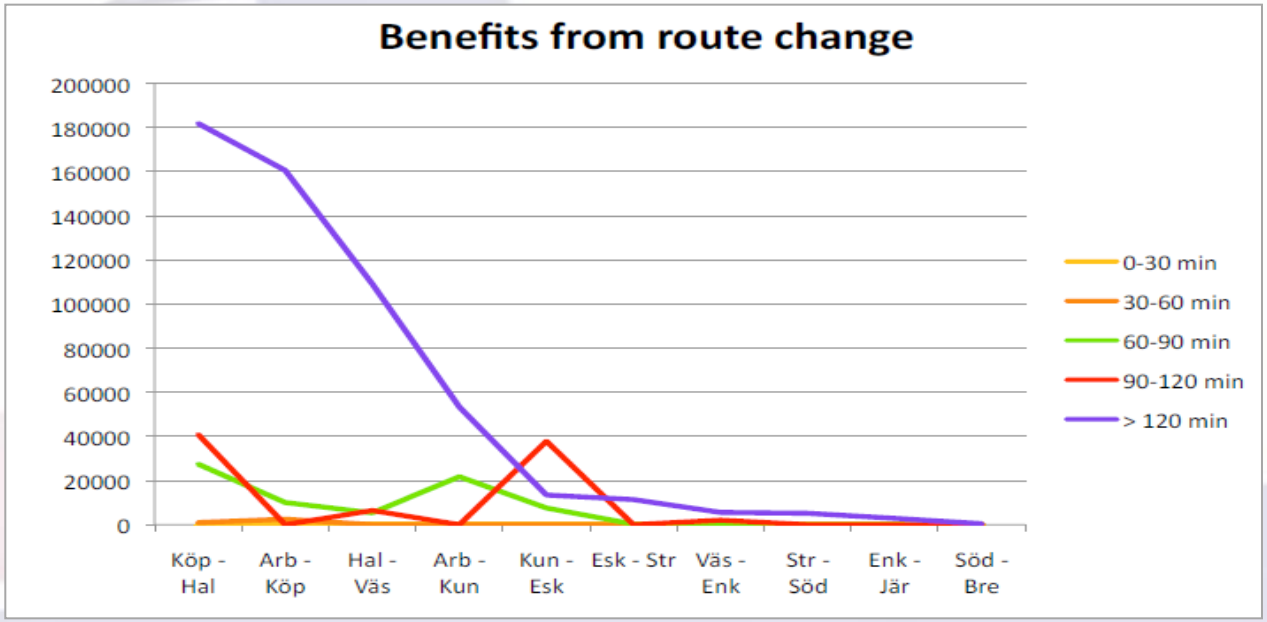
2. VSL Application



***Measured Accident cost reduction due to VSL application** (Gunnar Lind, "Cost-Benefit Analysis of ITS", Movea Trafikkonsult AB, April 2009.)*

VSL application

3. VMS Application

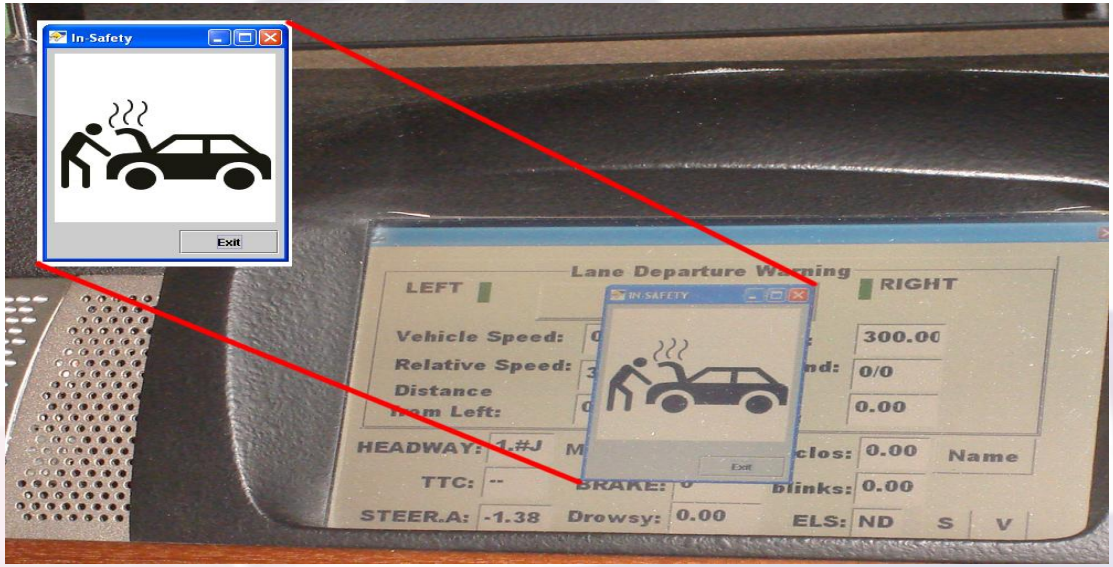


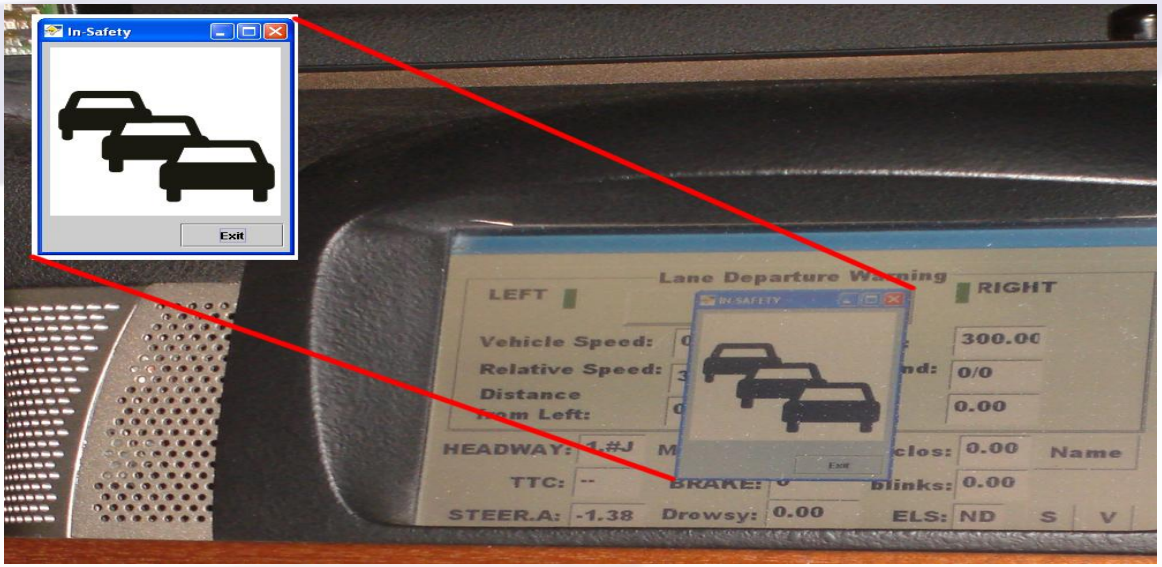
Time benefits due to early warning on road closure or accident ahead through VMS (Gunnar Lind, "Cost-Benefit Analysis of ITS", Movea Trafikkonsult AB, April 2009.)

VMS application

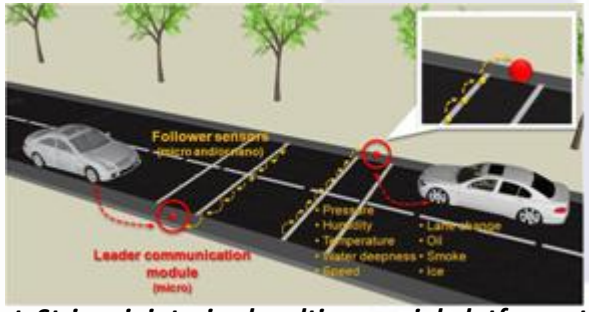
IN-SAFETY infrastructure node equipment

In vehicle personalized priority information…

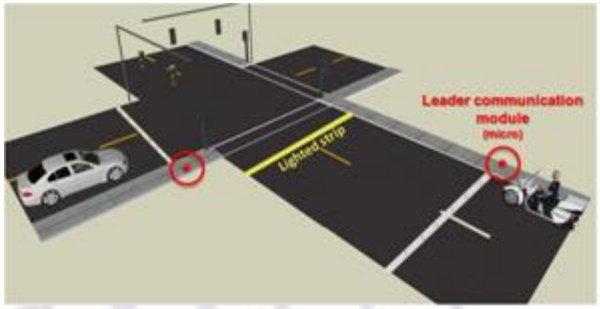




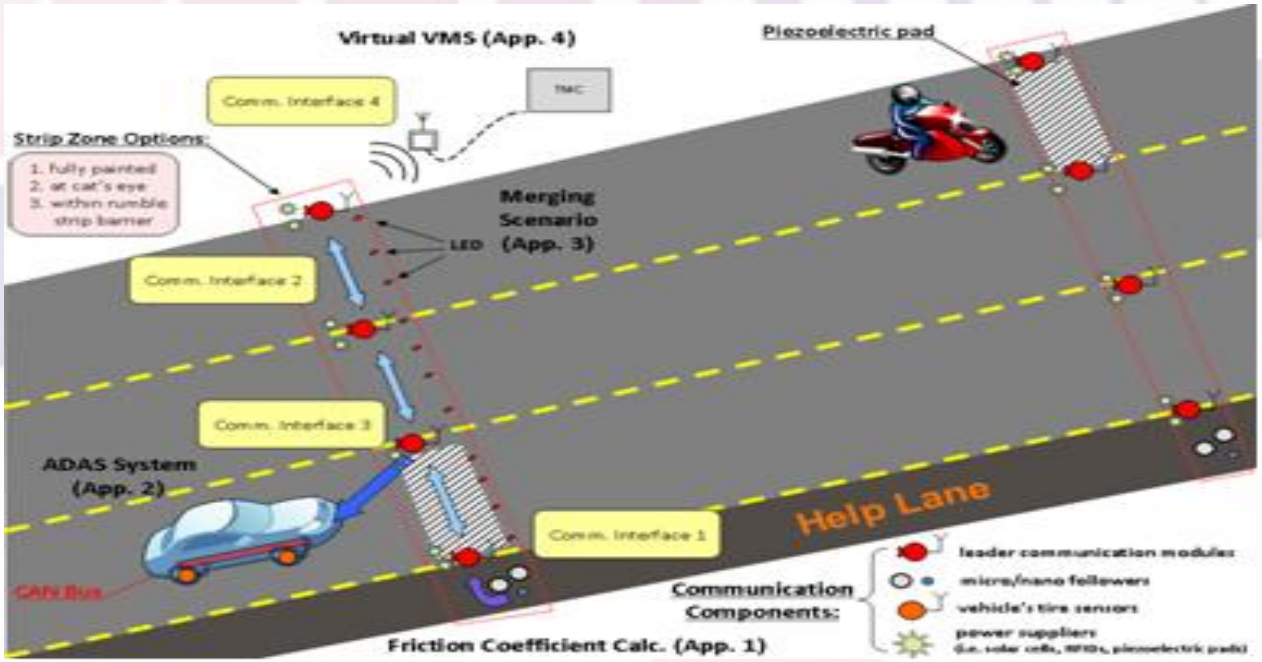
4. Smart Strip Concept



Smart Strip miniaturised multi-sensorial platform at a highway or rural environment.



Smart Strip miniaturised multisensorial platform at an intersection/ merging application.



Smart Strip "Highway" scenario

Smart Strip Type-applications:

- **Magnetic sensors for traffic management**

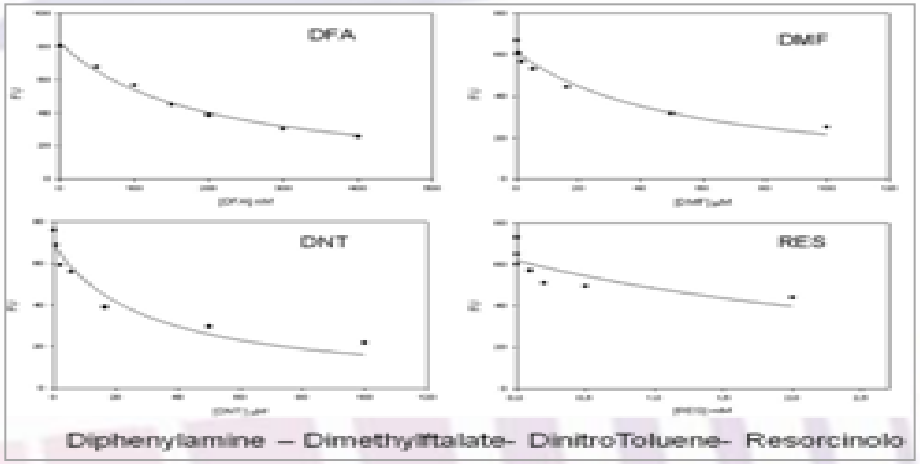
Magnetic sensors dedicated to various applications that provide relevant information such as:

- Basic vehicle detection
- Raw classification of vehicle
- Local speed estimation; acceleration; lateral position in lane
- Lane change detection
- By sensing data in spaced strips (sparse or dense) much richer information can be obtained with sensor data fusion (e.g. object tracking).

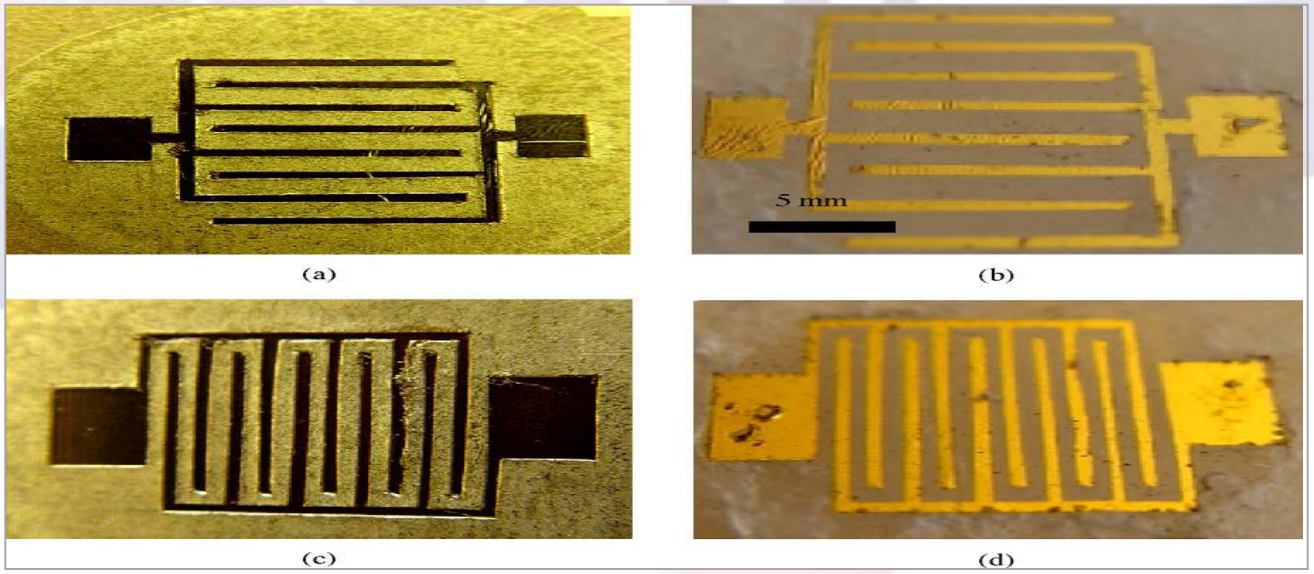
- **Passive follower sensors embedded in road**

Such a system will require a larger frequency spectrum to be operational than the standard RFID bands (e.g. 125 kHz & 13.56 MHz).

➢ Nanosensors for road and environmental sensing



Smoke detection by optically active molecules



Photos of the two humidity sensors fabricated on polycarbonate membranes with adhesive paper shadow masks.

5. Standardization of Electronic Info

	UN	LUOMA	CEDR	WHITE BOOK	TROPIC
ACCIDENT	 	  			     

Based upon an extension of standard signs standardization (Vienna Convention)

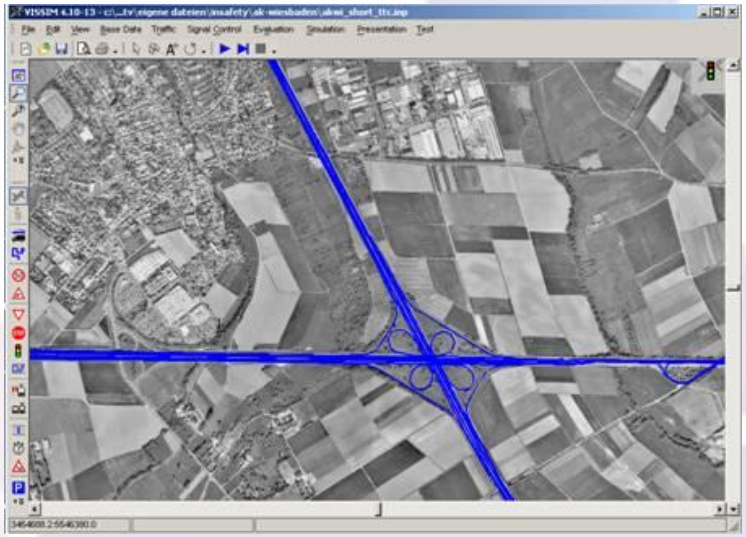
Vienna Convention	Austria	Denmark	Germany	Sweden	United Kingdom	Netherlands	Hungary	Greece	Italy	France	Romania
1. A–31 Cross winds											
2. A–14 Cyclists entering or crossing											
3. A–4a Carriageway narrows both sides											
4. A–4b Carriageway narrows one side											
5. A–32 Danger											

Also of sign verbalism (“EUROPEANISMS”)

IT22											
Country	Source Language (ISO 3166)	Info supplier	Traffic sign (graphical representation)	Name	Source	Descript-ion en	Descript-ion nat	Comment en	morphological element(s) of graphical representation	RDS text(s)	RDS code(s) source
InSafety EU	en	IIID		Park and Ride	ResultsDesPsychVieOct05-10/3.3.2.2			see also Europeanisms: METRO/U (IT39),TRAM (IT34),BUS (IT05, IT39); P+R understood/ pictogramme preferred			
InSafety EU	en	IIID		Park and Ride	ResultsDesPsychVieOct05-10/3.3.2.2						
InSafety EU	en	IIID		Park and Ride	ResultsDesPsychVieOct05-10/3.3.2.2						
InSafety EU	en	IIID		Park and Ride	ResultsDesPsychVieOct05-10/3.3.2.2						
InSafety EU	en	IIID		Park and Ride	ResultsDesPsychVieOct05-10/3.3.2.2						
UN	en	Infoterm			VC1968/E,14c			see also IT 34 Public transport:TRAM			
	en	Infoterm			VC1968/E,14b			see also IT 39 Public transport:METRO			
C	English										
	L1										
	L2										

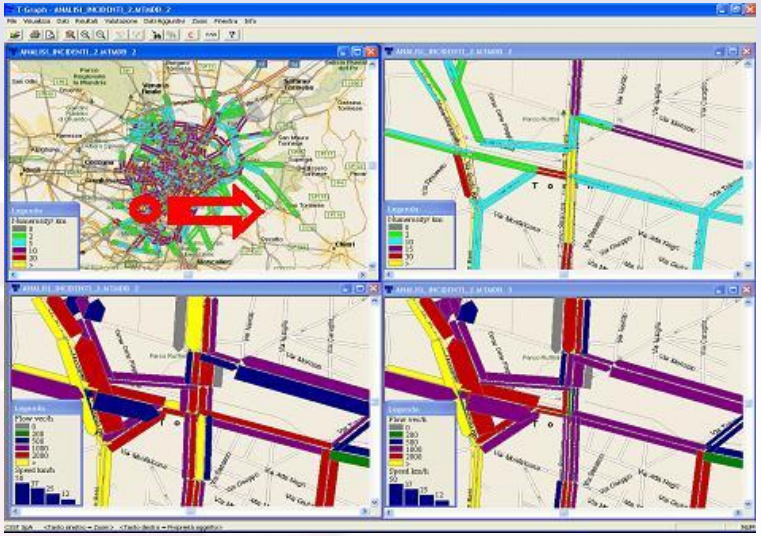
6. Modelling

Micro and macro modelling:



VISSIM

MT Model



Steps to be taken…

- Initial model adapted for Traffic Safety impact analysis.
- ADAS equipped vehicles of different types (car, truck, PTW) modelled.
- Run without ADAS.
- Run with “ideal” ADAS behavior.
- Run with real ADAS behavior.
- Run with multiple ADAS.

➢All for different penetration rates and road types.

7. Training

Operators' Training MMT:

www.insafety-eu.org

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Finally…

Towards a real self-explanatory and comfortable driving environment….

CENTER FOR RESEARCH AND TECHNOLOGY HELLAS

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…and a forgiving one too!!!

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