SAFESPOT Integrated Project

Co-operative Systems for Road Safety "Smart Vehicles on Smart Roads"

Roberto Brignolo
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IP Coordinator

The SAFESPOT CONCEPT

COOPERATIVE SYSTEMS FOR ROAD SAFETY:

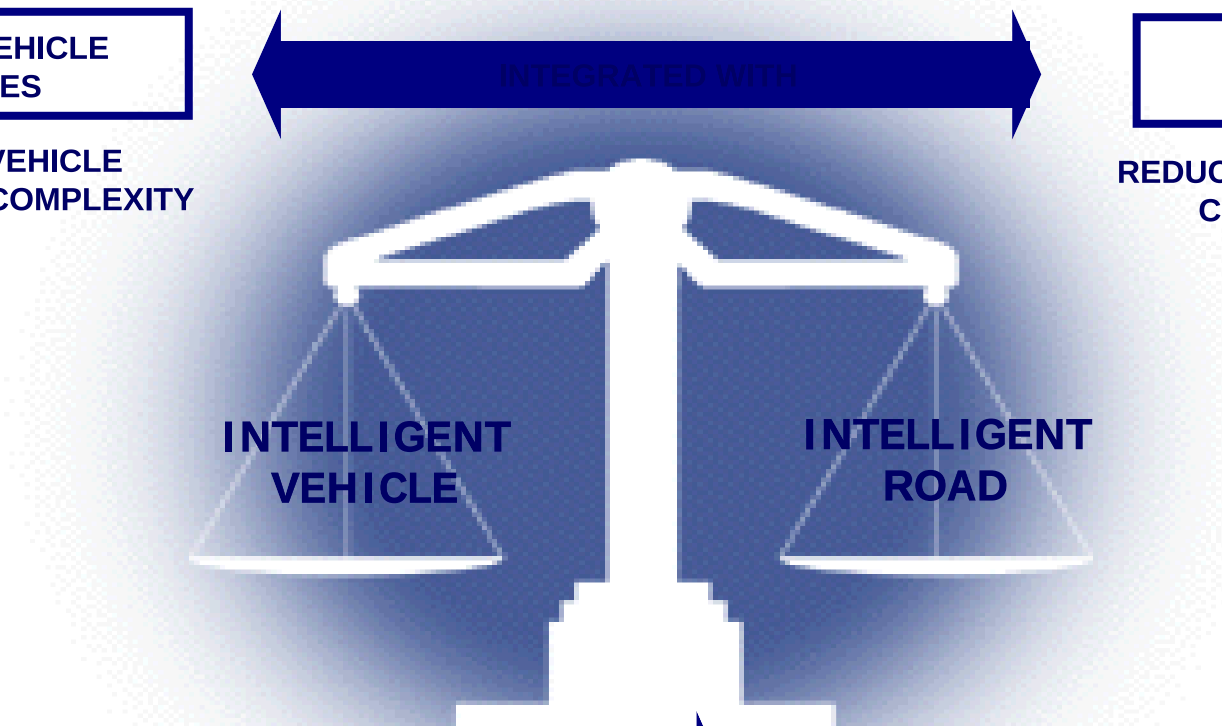
“SMART VEHICLES” ON “SMART ROADS”

INTELLIGENT VEHICLE ADVANTAGES

REDUCTION OF VEHICLE SYSTEM COST AND COMPLEXITY

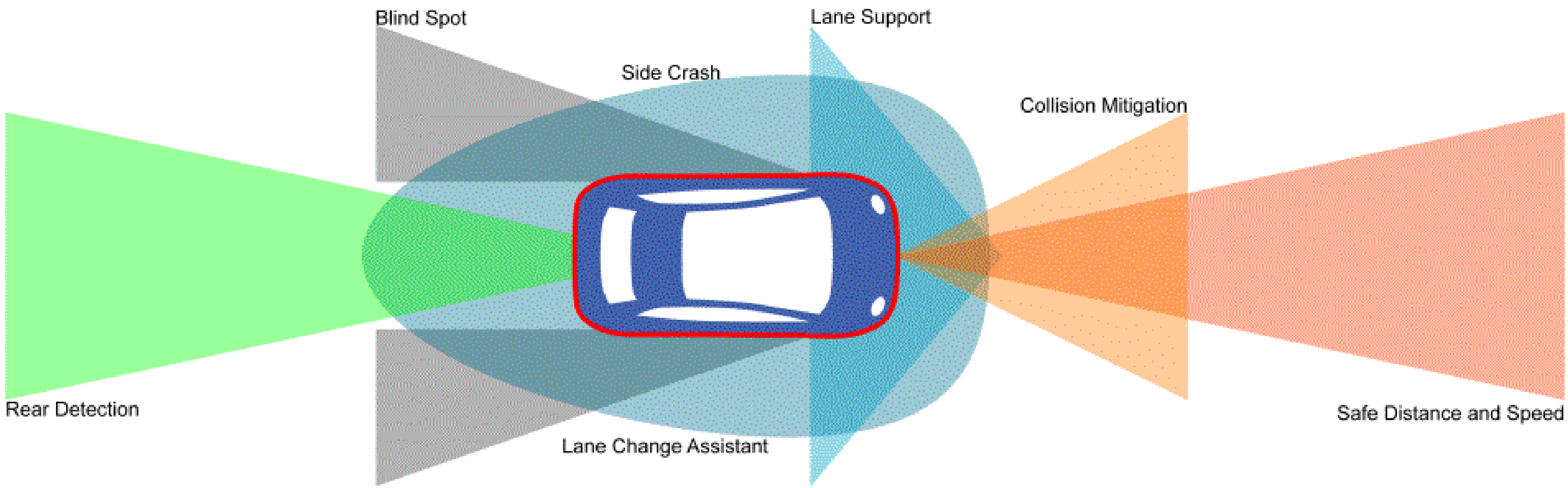
INTELLIGENT ROAD ADVANTAGES

REDUCTION OF INFRASTRUCTURE COST AND COMPLEXITY

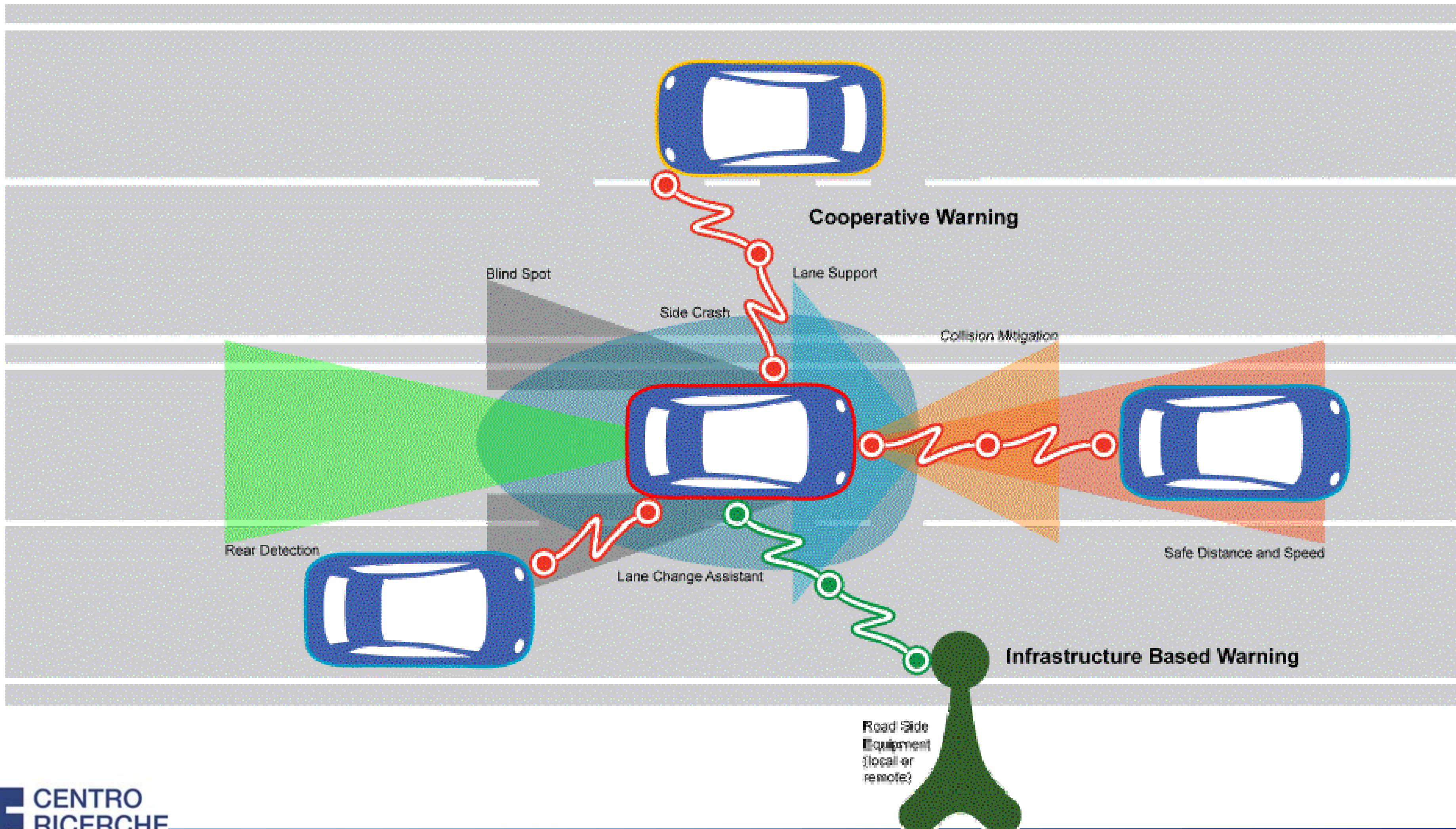


sustainable deployment ➔ **increased safety**

The SAFESPOT CONCEPT: from the autonomous intelligent vehicle…



The SAFESPOT CONCEPT: … to intelligent Cooperative Systems



SAFESPOT Integrated Project
Cooperative Systems for Road Safety
"Smart Vehicles on Smart Roads"

SAFESPOT is working to design intelligent cooperative systems based on vehicle to vehicle and vehicle to infrastructure communication to produce a breakthrough for road safety.

SAFESPOT will prevent road accidents developing a:

"SAFETY MARGIN ASSISTANT"

to detect in advance potentially dangerous situations and extend, in space and time, drivers' awareness of the surroundings.

Project type: Integrated Project (IP)

Co-funded by the European Commission Information Society and Media in the

6th Framework Programme

Consortium : 51 partners from 12 European countries:

- OEM (trucks, cars, motorcycles)
- ROAD OPERATORS
- SUPPLIERS
- RESEARCH INSTITUTES
- UNIVERSITIES

Promoted by: EUCAR

Timeframe: Feb. 2006 – Jan. 2010

Overall Cost Budget : 38 M€

(European Commission funding 20.5M€)

IP coordinator : Roberto Brignolo
C.R.F. Centro Ricerche Fiat (Italy)

SAFESPOT Consortium

Company	Nationality
Centro Ricerche Fiat ScpA	IT
DaimlerChrysler AG	DE
Renault FRANCE, REGIENOV	FR
Volvo Technology Corporation	SE
Robert BOSCH GmbH	DE
SIEMENS AG	DE
ANAS SpA	IT
Compagnie Financière et Industrielle des Autoroutes	FR
Netherlands Organisation for Applied Scientific Research	NL
MIZAR Automazione S.p.A.	IT
Piaggio & C. SPA	IT
Continental Teves AG & Co oHG	DE
IBEO Automobile Sensor GmbH	DE
Kapsch TrafficCom AB	SE
LACROIX TRAFIC	FR
NAVTEQ Europe B.V.	NL
Planung Transport Verkehr AG	DE
Q-Free ASA	NW
Peek Traffic solutions	NL
Tele Atlas NV	NL
VTT Technical Research Centre of Finland	SF
Autostrada Brescia Verona Vicenza Padova S.p.A.	IT
CG Côtes d'Armor	FR
Swedish Road Administration	SE
CIDAUT: Fundación para la Investigación y Desarrollo en Automoción	ES

SAFESPOT Consortium

Company	Nationality
Centro Studi sui Sistemi di Trasporto	IT
Dipartimento di Ingegneria Biofisica ed Elettronica - Università degli Studi di Genova	IT
Centre for Research and Technology - Hellas	EL
Institute of Communication and Computer Systems	EL
Laboratoire Central des Ponts et Chaussées	FR
Istituto Superiore Mario Boella	IT
MIRA Limited	UK
Société pour le Développement de l'Innovation dans les Transports	FR
Rijkswaterstaat	NL
Technische Universität Chemnitz	DE
Technische Universität Muenchen	DE
University of Stuttgart	DE
German Aerospace Center	DE
European Road Transport Telematics Implementation coordination Organization Scrl	BE
Center for Research and Telecommunication Experimentation for NETworked Communities	IT
Politechnika Warszawska	PL
Budapest University of Technology and Economics	HU
Centre National de la Recherche Scientifique	FR
Bundesanstalt für Strassenwesen	DE
Thomas Miller & co. Ltd	UK
Provincie Noord-Brabant	NL
Renault Spain	ES
Universidad Politécnica de Madrid	ES
Telefónica Investigación y Desarrollo Sociedad Anónima Unipersonal	ES
AT4 Wireless	ES
Magneti Marelli Electronic Systems	IT

SAFESPOT Consortium

SAFESPOT SPECIFIC OBJECTIVES

- To **use the infrastructure and the vehicles as sources (and destinations) of safety-related information** and develop an open, flexible and modular architecture and communication platform.
- To develop the **key enabling technologies**:
  ad-hoc dynamic networking, **accurate relative localisation**, **dynamic local traffic maps.**
- To develop a new generation of infrastructure-based sensing techniques.
- To develop and test scenario-based applications to evaluate the impacts and the end-user acceptance.
- To define the practical implementation of such systems, especially in the initial period when not all vehicles will be equipped.
- To evaluate the liability aspects, regulations and standardisation issues which can affect the implementation.

SAFESPOT STRUCTURE

COORDINATION LAYERS

- HORIZONTAL ACTIVITIES
- SAFESPOT CORE ARCHITECTURE
- BUSINESS MODELS, LEGAL ASPECT & DEPLOYMENT

TECHNOLOGIES ORIENTED SUB-PROJECTS

Information Sources

- IN VEHICLE SENSING & PLATFORM
- INFRASTRUCTURE SENSING & PLATFORM

Innovative Technologies

- ACCURATE COOPERATIVE LOCALISATION
- DYNAMIC LOCAL MAPS
- AD HOC COMMUNICATION NETWORKING

Test beds

- Vehicle Platform
- Infrastructure Platform

APPLICATIONS ORIENTED SUB-PROJECTS

Applications/ Scenarios

- COOPERATIVE SYSTEMS APPL. VEHICLE BASED
- Freeflow
- Tunnels, bridges
- Black Spot
- COOPERATIVE SAFETY SYSTEMS INFRASTRUCTURE BASED

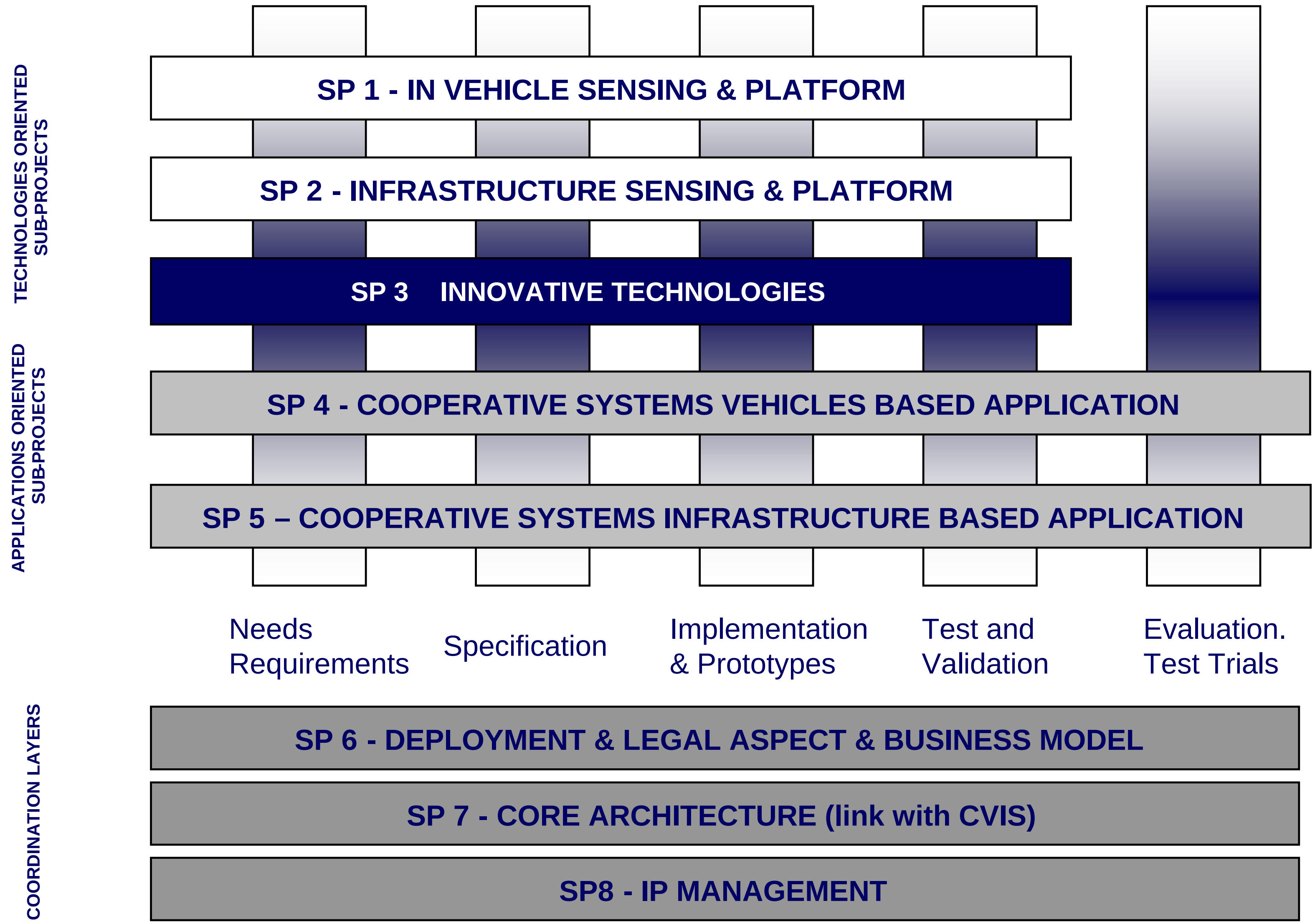
Test sites

- ITALY
- GERMANY
- FRANCE
- SWEDEN
- NETHERLANDS

Validation Evaluation

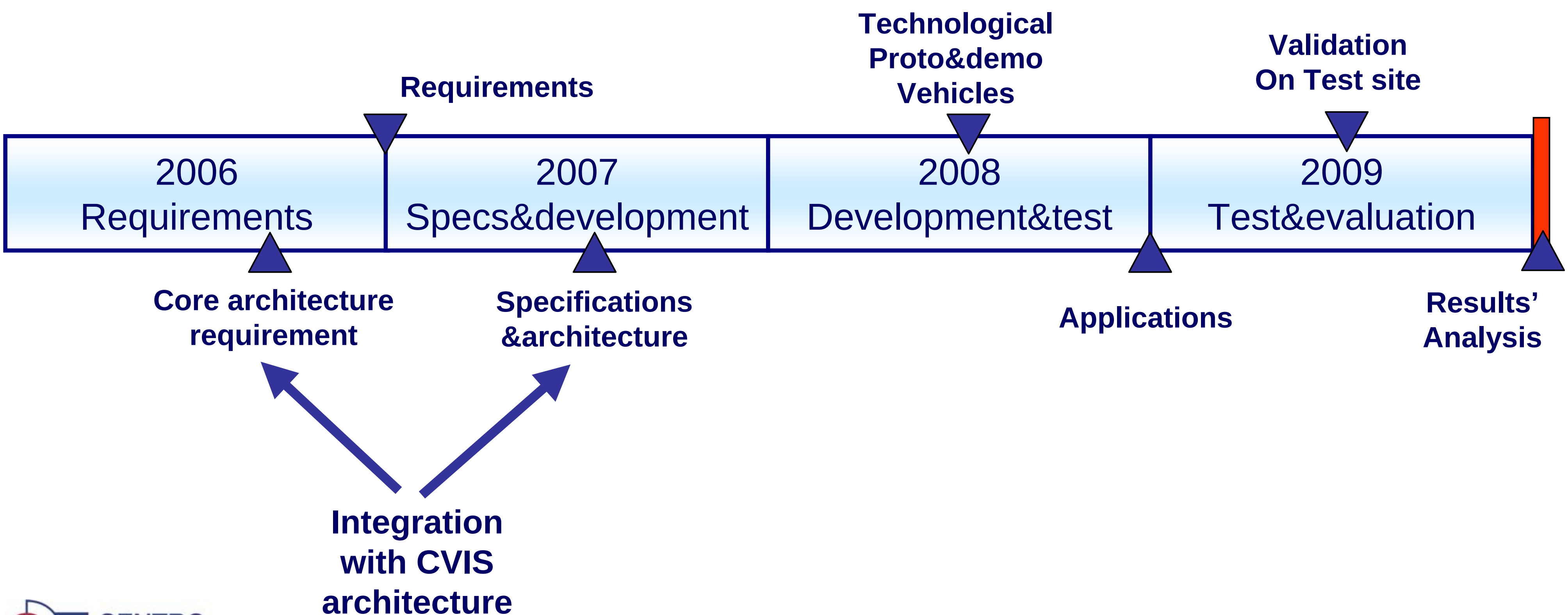
- COOPERATIVE SYSTEMS APPL. VEHICLE BASED
- COOPERATIVE SAFETY SYSTEMS INFRASTRUCTURE BASED

SAFESPOT Sub-Projects

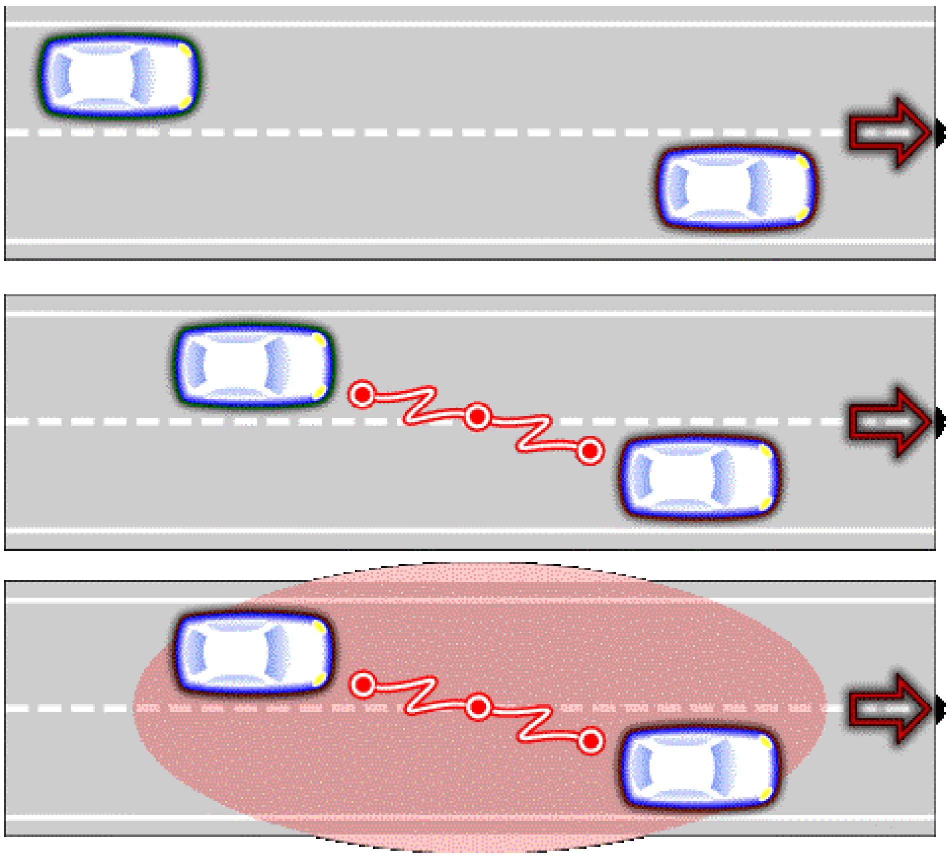


SAFESPOT TIME FRAME

Test sites in Europe:
France, Germany, Italy, Spain,
Sweden, the Netherlands



SAFESPOT applications will allow the extension of the "Safety Margin": the time in which a potential accident is detected before it may occur (e.g. in static and dynamic black spots)



SAFESPOT applications are based on V2V and V2I communications

The objectives are:

- to improve the range, quality and reliability of the safety-related information available to 'intelligent vehicles' by providing **'extended co-operative awareness'** through the real time reconstruction of the driving context and environment
- to support drivers preventively to the proper manoeuvres in the different contexts
- to optimise the intervention of vehicle controls with respect to critical situations
- to manage existing incidents to minimise further negative safety impact
- to open the development of new safety applications based on the cooperative approach
- to increase the safety for all road users

From the network architecture standpoint, roadside components take part to the vehicle-vehicle-infrastructure communication network as "standing" nodes. This means not only to use the same communication platform, but also to be visible and recognisable by any V2V equipped vehicle.

SAFESPOT application scenarios are static and dynamic black spots

STATIC BLACK SPOTS or “static risky conditions” are road scenarios intrinsically dangerous, whose dangerousness is evident in accidents statistics (e.g. narrow curves, tunnels, bridges).
Static black spots are the first addressed implementation areas for infrastructure sensing for road safety.
These scenarios are typically addressed by V2I applications, the information will also be propagated via V2V multi-hop communication to extend the safety margin to all incoming vehicles.

DYNAMIC BLACK SPOTS or “dynamic risky conditions” are driving scenarios that become unexpectedly and suddenly dangerous for adverse environmental conditions or for very critical traffic situations. (e.g. fog, ice conditions, a queue behind a curve, a vehicle that suddenly harshly brakes, presence of vehicles in blind spots, etc.)
These scenarios are both addressed by V2V and by V2I based applications.

The scenarios that are presenting **“quasi static risky conditions”** for most of the time (e.g ice on the road in Northern countries) will be treated mostly via V2I but also via V2V for the information propagation.

SAFESPOT application scenarios: some examples

The objective is to keep all vehicles in the “safety margin” that is to inform drivers about a potential risk sufficiently in advance to avoid emergency manoeuvres.

Safe lane change manoeuvres
Vehicles in the blind spots and vehicles that are intending to change lanes are detected in advance to promptly inform all drivers of relevant vehicles.

Road departure prevention
Information on recommended speed is sent from the infrastructure to the vehicles according to road geometry, surface status and traffic conditions.
Vehicles equipped with sensors measuring road friction communicate to the other vehicles the presence of slippery roads.

Cooperative manoeuvring (e.g. highway merging)
Vehicles calculate in real time their relative position and trajectories, when a risky situation and a potential collision is detected, drivers of relevant vehicles are promptly warned.

SAFESPOT application scenarios: some examples

Cooperative tunnel safety

The infrastructure informs the vehicles about recommended speed and safety distance. The Safety Margin is calculated on the basis of the vehicle type and conditions.

Hazard and incident warning

Transmission of warning messages to vehicles arriving on an area where an accident has just occurred. The message can be issued from the infrastructure or from other vehicles and includes: type of hazard, current location and previous positions, speed, direction.

Safe urban / extra urban intersections

This application requires a very precise computation of the vehicles trajectories and local digital maps of the intersections. The infrastructure delivers information to the vehicles to recognize dangerous situations in time.

SAFESPOT KEY TECHNOLOGICAL CHALLENGES

Reliable, fast, secure, potentially low cost protocols for local V2V and V2I **communication**

- Candidate radio technology: IEEE 802.11p
- Need for dedicated frequency band for secure V2V and V2I, avoiding interference with existing consumer links
- Aligned to C2C-C and CALM standardisation groups

A reliable, very accurate, real-time **relative positioning**

A real time updateable **Local Dynamic Map**

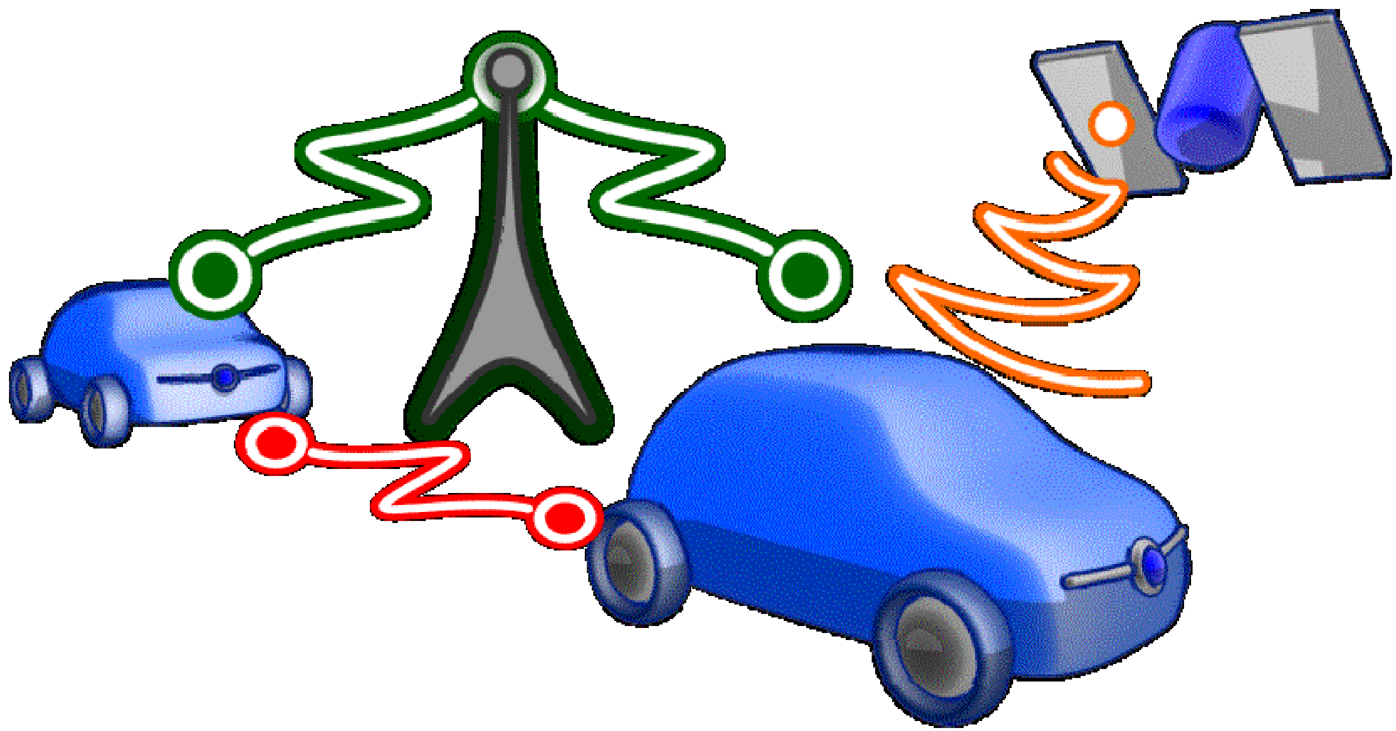
ACCURATE POSITIONING

A reliable, very accurate, real-time relative positioning:

- Satellite raw data (pseudo-ranges) enhancing the proven differential procedures (DGPS).
- Use of landmarks registered on digital maps.

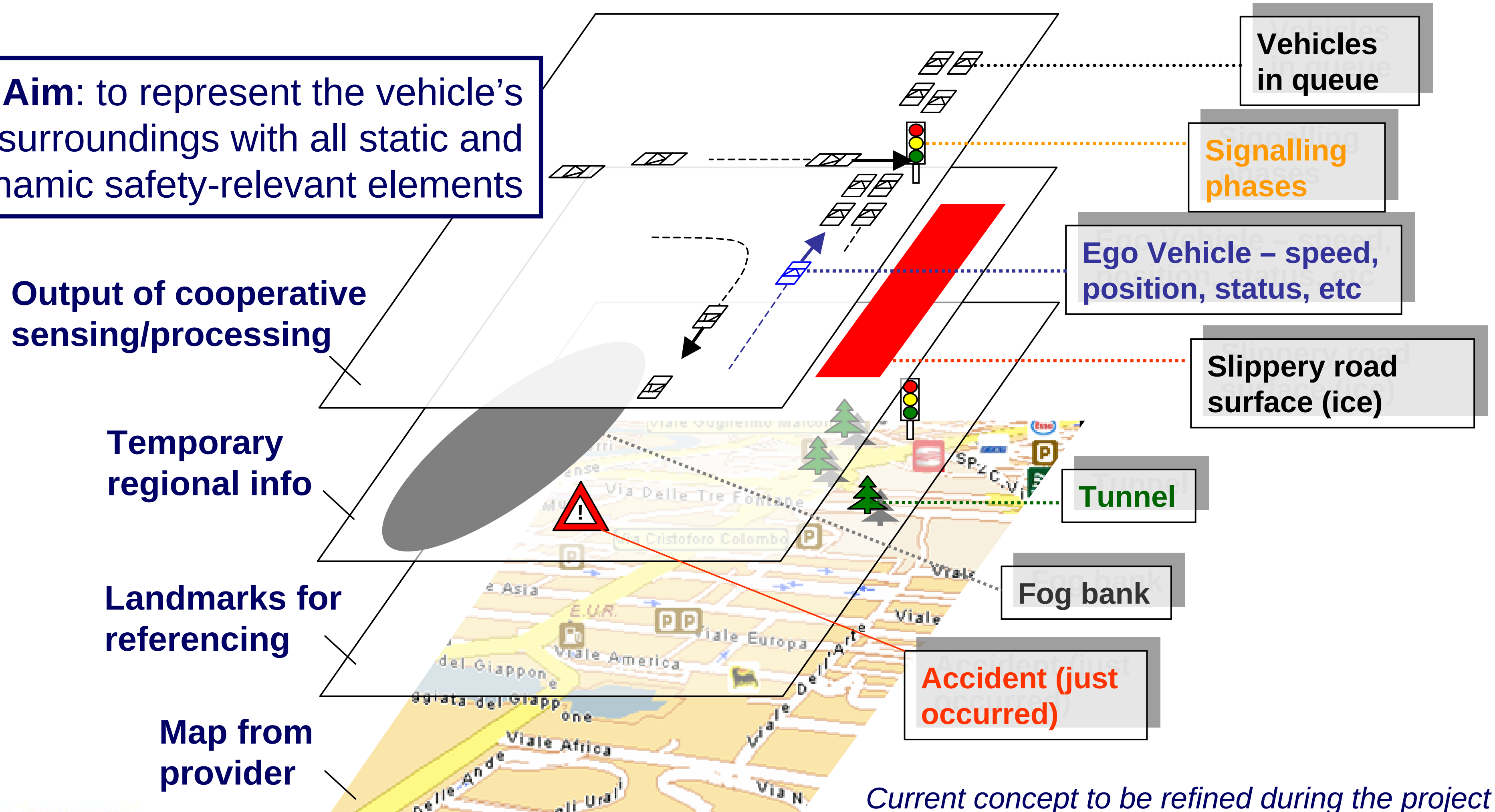
DATA FUSION ALGORITHMS

DGPS
Vehicle sensors' data
Landmarks
Other vehicles' positions

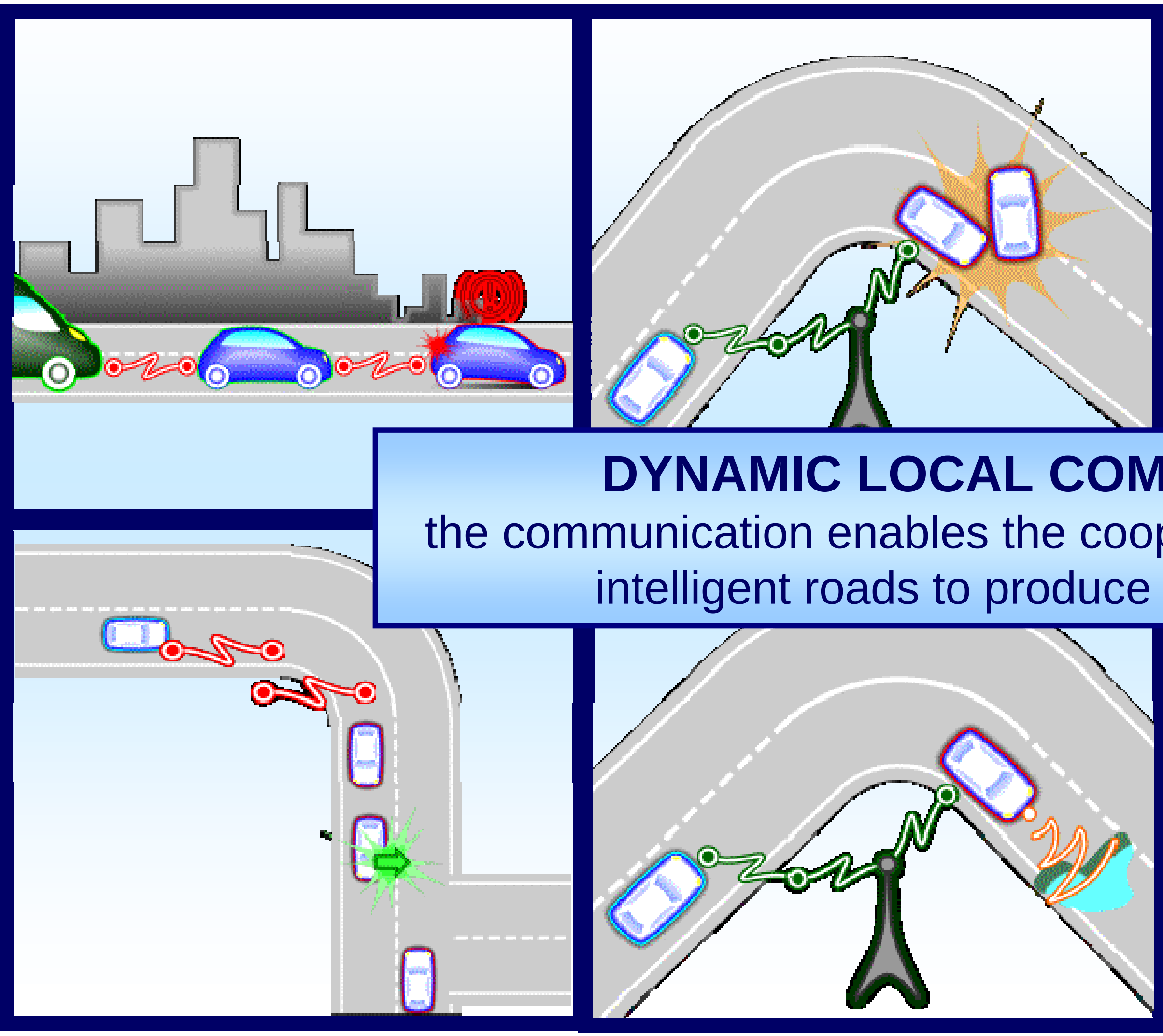


LOCAL DYNAMIC MAPS

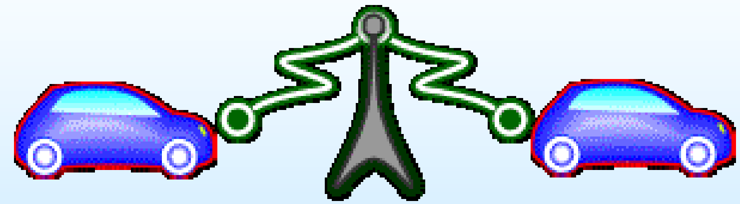
Aim: to represent the vehicle's surroundings with all static and dynamic safety-relevant elements



Current concept to be refined during the project



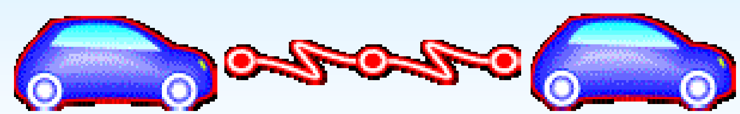
VEHICLE TO INFRASTRUCTURE (V2I)



INFRASTRUCTURE TO VEHICLE (I2V)

DYNAMIC LOCAL COMMUNICATION NETWORK

the communication enables the cooperation among intelligent vehicles and intelligent roads to produce a breakthrough for road safety



VEHICLE TO VEHICLE (V2V)

SAFESPOT Integrated Project

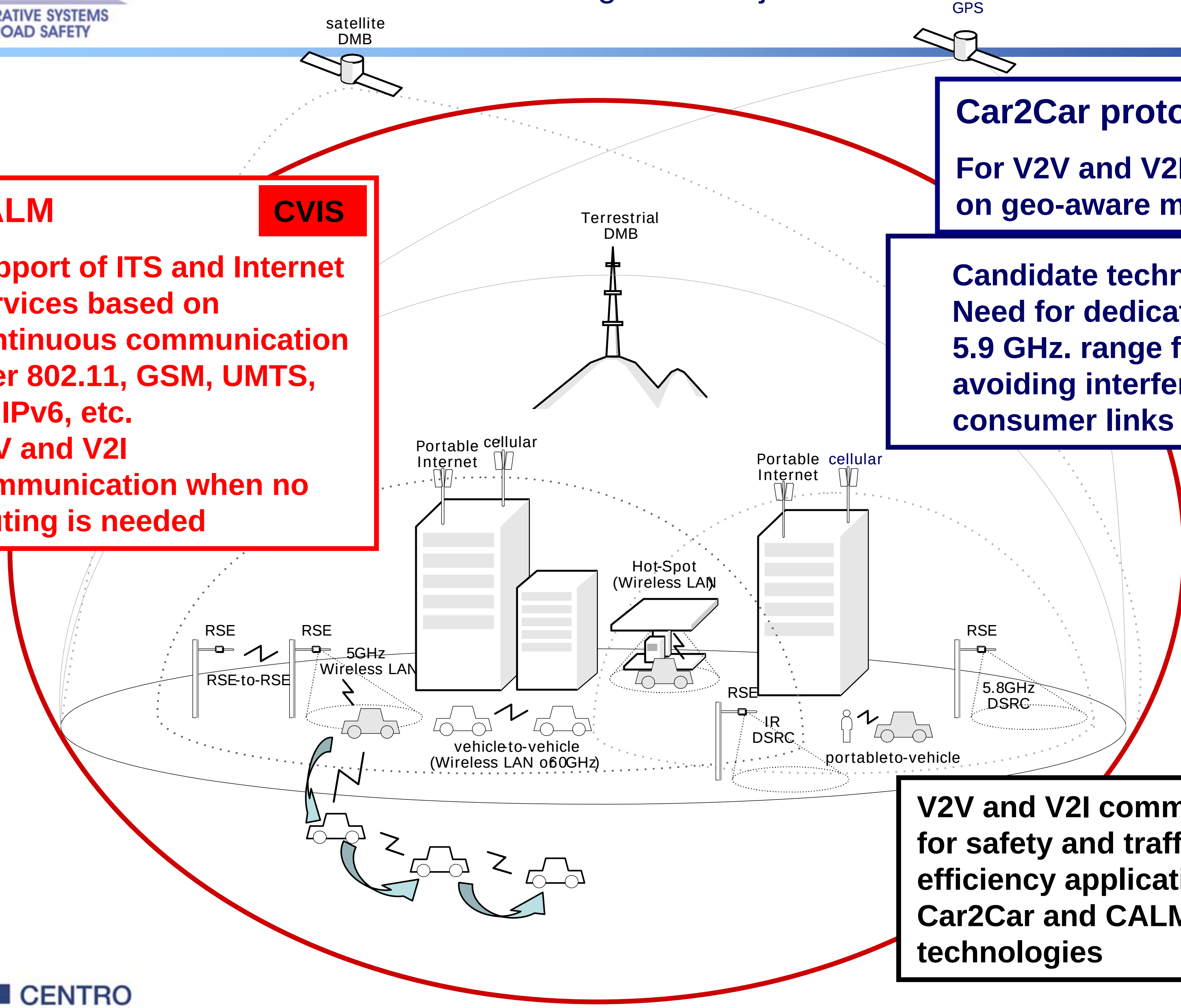
CALM
CVIS

Support of ITS and Internet Services based on continuous communication over 802.11, GSM, UMTS, IR, IPv6, etc.
V2V and V2I communication when no routing is needed

Car2Car protocol
SAFESPOT

For V2V and V2I communication, based on geo-aware multi-hop routing

Candidate technology: IEEE 802.11p
Need for dedicated frequency band in the 5.9 GHz. range for secure V2V and V2I, avoiding interference with existing consumer links



V2V and V2I communication for safety and traffic efficiency applications using Car2Car and CALM technologies

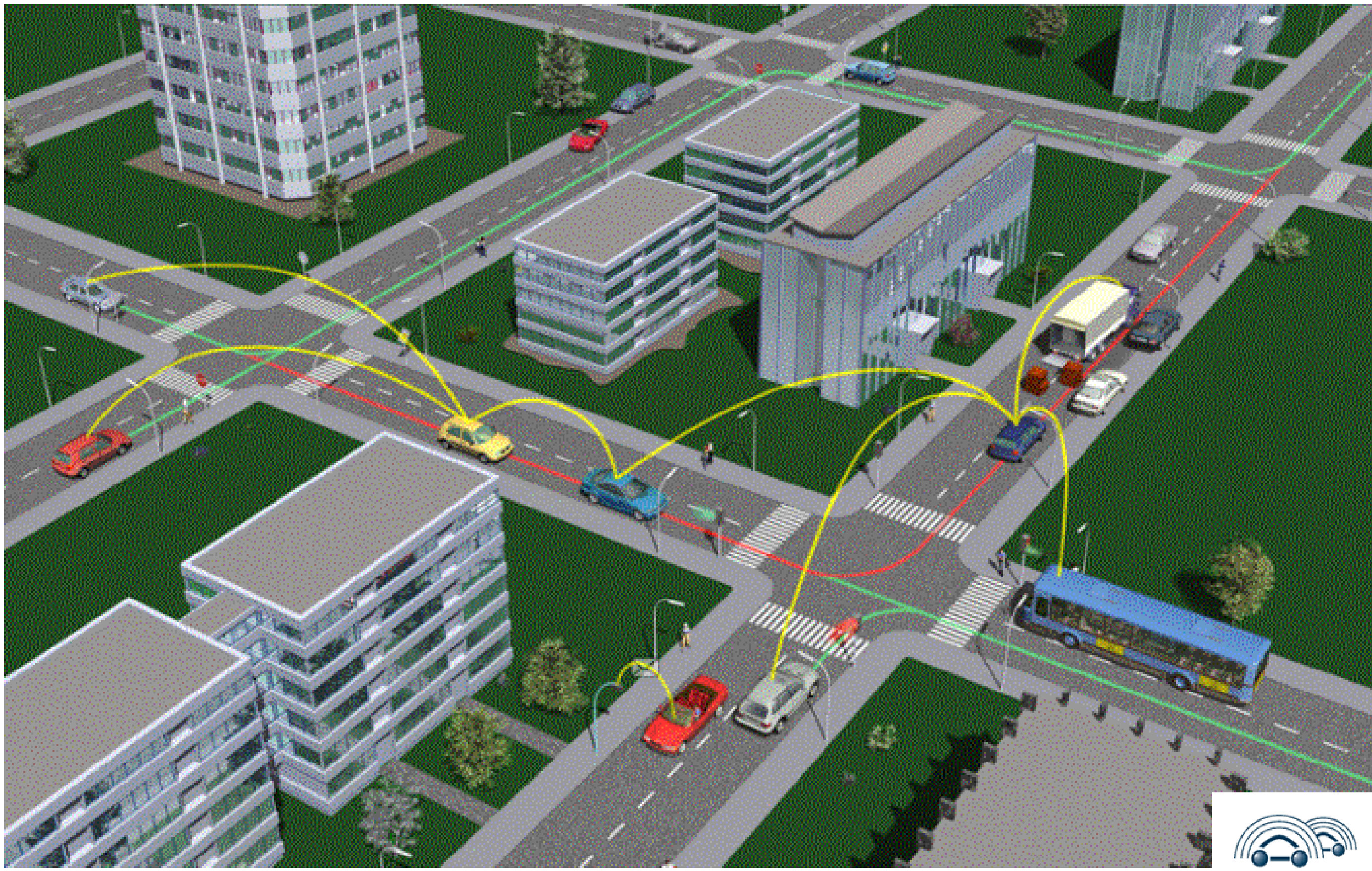
high accuracy positioning, ad hoc networking, local dynamic maps, warning strategies, sensor fusion, experimentations, investments, stakeholder cooperation, standardisation, frequency spectrum allocation, human factors, human reactions, social acceptance, road user awareness, privacy, reliability, integrity,
security, partial coverage, ……..

COOPERATIVE SAFETY SYSTEMS have to face and to overcome highly challenging system, technological, organizational and societal aspects.

but ....

they have a very high potential
for dramatically improving road safety

COOPERATIVE SYSTEMS development and deployment need stakeholders' cooperation



CAR 2 CAR COMMUNICATION CONSORTIUM

SAFESPOT will improve competitiveness for all stakeholders

The cooperative approach will enable the optimal solution, in terms of cost/benefits ratio, for all involved players

Car makers will open new market opportunities offering on the market new functions for safer vehicles at sustainable costs as the “intelligence” will be distributed. The level of complexity of vehicles will be sensibly decreased, compared to autonomous solutions.

Suppliers will meet the challenge of new market opportunities: they want to be prepared to offer fully developed technical solutions and intend to actively drive the evolution in terms of concept generation, technical evaluation, standardisation, public work.

Road operators and public authorities will improve road safety on motorways and urban roads via a combination of infrastructure and vehicle systems, that will collect and transmit in real time traffic, weather and accident information to all road users and to traffic information centres.

REFERENCES

IP web site www.safespot-eu.org

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