Navigation, Cooperative Driving and EcoMobility

NAVIGARE 2010, 30.06.2010
Jean-Charles Pandazis
Presentation overview

» ERTICO and EcoMobility
» Main steps in vehicle navigation
» green -ITS, -navigation and -driving
» Added value of cooperative systems and services
» eCoMove showing the way
» Standardisation as key enabler
» Conclusion
ERTICO is

» A platform for multi-sector partnership
» Advancing R&D and supporting the market introduction of ITS (Intelligent Transport Systems & Services)
» Fully Partner-driven with organisations from:
  › Industry
  › Infrastructure & telecom operators
  › Public authorities
  › Users
  › Others (research institutes, associations)

to promote ITS in Europe
### ERTICO Partners

#### Public Authorities

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<tr>
<th>Country</th>
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<tbody>
<tr>
<td>Austria</td>
<td>Federal Ministry for Transport, Innovation &amp; Technology</td>
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<td>Belgium</td>
<td>Vlaamse Overheid - Dept. Mobility &amp; Public Works</td>
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<td>Czech Republic</td>
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<td>North Denmark Region Danish Road Directorate</td>
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<td>Germany</td>
<td>DLR - German Aerospace Center Federal Ministry of Transport, Building &amp;</td>
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<td>Luxembourg</td>
<td>Administration des Ponts et Chaussées</td>
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<td>Poland</td>
<td>Directorate National Roads &amp; Motorways</td>
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<td>Portugal</td>
<td>IMTT - Institute for Mobility and Land Transport EP - Portuguese National</td>
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<td>Road Authority</td>
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<td>Saudi Arabia</td>
<td>Ministry of Transport</td>
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<td>Slovak Republic</td>
<td>Ministry of Transport, Posts &amp; Telecommunications</td>
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<td>Direccrte - General of Road Transport, Ministry of Internal Development</td>
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<td>Banverket - Swedish National Rail Admin.</td>
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<td>SRA - Swedish Road Administration</td>
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<td>FEDRO - Swiss Federal Roads Office</td>
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<td>United Kingdom</td>
<td>DfT - Department for Transport</td>
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#### Industry

- Allianz AG
- AVL List
- BMW Group
- Cobra Automotive Technologies SpA
- Continental AG
- Denso Europe BV
- Efkon AG
- Ericsson AB
- Fiat Group
- Honda Motor Europe
- Kapsch TrafficCom AG
- Logica
- MetaSystem SpA
- Mitsubishi Electric Automotive Europe
- Mitar Automazione SpA
- Navteq
- NEC Europe Ltd
- Nissan Motor Manufacturing (UK) Ltd - Belgian Branch
- NXP Semiconductors
- Panasonic Automotive Systems Europe GmbH
- Peek Traffic BV
- PlusService srl
- PTV Planung Transport und Verkehr AG
- Q-Free ASA
- Ramsys
- Renault
- Robert Bosch GmbH
- Satellic Traffic Management (member of T-Systems)
- Siemens AG
- Technology BV
- Tele Atlas - TomTom
- Thetis SpA
- Toyota Motor Europe
- Vialis
- Volkswagen AG
- Volvo Car Corporation (representing Ford)
- Volvo Technology Corp. (representing Volvo Group)
- WirelessCar (representing Volvo Info. Technology)
- Ygomi Europe Kft

#### Infrastructure Operators

- ASFA - Association Professionelle Autoroutes et ouvrages routiers
- Egis
- Telecom Italia SpA
- Vodafone

#### Users

- ADAC e.V. - Allgemeiner Deutscher Automobil-Club
- ANWB - Royal Dutch Touring Club
- RACC - Relat Automobil Club de Catalunya

#### Others

- ACEA - Association des Constructeurs Européens d'Automobiles
- CERTH - Centre for Research and Technology Hellas
- CTAG - Automotive Technological Centre of Galicia (Spain)
- Dekra e.V. - Deutscher Kraftfahrzeug Ueberwachungsverein
- FIA - Federation International de l'Automobile
- ICCS - Institute of Communication and Computer Systems
- InnoviTS
- IRU - International Road Transport Union
- ISMB - Istituto Superiore Mario Boella
- Sinter
- Tecnalia
- TNO - Traffic and Transport
- VDA - German Association of the Automobile Industry
ERTICO vision

“Intelligent Mobility”

» Towards zero accidents
» Towards zero delays
» With reduced impact on the environment
» Towards fully informed people
  › where services are affordable and seamless
  › privacy is respected and
  › security is provided
EcoMobility @ ERTICO

... with reduced impact on our environment

**Eco-smart driving**
- support drivers to adopt and then maintain a fuel-efficient driving behaviour.

**Eco-freight and logistics**
- enable freight routing and logistic operations to optimise fuel consumption and green goods transport

**Eco-traffic management**
- implement traffic control and management systems improving global traffic network energy efficiency

**Eco-vehicles**
- integrate hybrid and electrical vehicles into the transport and energy network
Main steps in vehicle navigation

1985
- autarch navigation
  \textit{(ETAK, Travelpilot, Carin, \ldots)}

1990
- GPS based navigation

2000
- Dynamic navigation \textit{(use of TMC)}
- Predictive navigation \textit{(link to ADAS)}

2005
- Green routing and navigation

2010
- \ldots cooperative navigation

Keywords are prediction & connectivity
Identified measures with greatest potential for environmental benefits:

» Eco-driving support
» Eco-traffic management
» Eco-information and guidance
» Eco-demand and access management
» Eco-mobility services
» Eco-freight and logistics management
» Eco-monitoring and modelling.

... reliable and quantitative estimate of impacts not possible today

“WG believes that all potential Green ITS measures combined could bring reduction of fuel consumption & CO2 emissions of ~25%”
Green ITS

Company studies and previous research show that fuel reduction can be achieved from:

» coach & support drivers to drive fuel efficiently
  › eco-driving potential: 10-25% (Ecodriven project, 2008)
  › eco-driving ADAS support: 15-20% (German Research Initiative INVENT)

» avoiding unnecessary and/or “expensive” miles
  › navigation reduces distance travelled: 16% (TNO/TomTom)
  › navigation reduces fuel consumption, CO2: 12% (NAVTEQ)
  › fuel-optimised navigation: 4% overall, 8% cities (Lund)
Green ITS

Main functions for emission reduction

» Eco Routing:
  › Economic route calculation based on enhanced map attributes (e.g. curves, slopes, intersections, etc.)
  › Optimization by considering vehicle & engine type and driving behaviour

» Predictive Driving:
  › Driving recommendations (e.g. for speed, acceleration/brake points/intensity, etc.)
  › Predictive gear shift indication for manual gear boxes
  › Predictive speed and distance control (ACC & Speed control)
Green ITS

First systems and services on the market (1)

» PNDs with eco-routing, now also integrated in vehicles
e.g. TomTom Portable Navigation Device™ integratedwith the Blue&Me™ platform of FIAT

Use limited information to estimate the least fuel consuming route

The Eco-Drive information system records and processes data relating to the driving style, and
gives the driver with tips for reducing environmental impact and optimising fuel consumption.
Green ITS

First systems and services on the market (2) …

In-vehicle telematics unit for eco-driving support:
» in-vehicle in-built systems, e.g.
• Honda Ecological Drive Assist
» off-line analysis systems, e.g.
• Dynafleet (Volvo Trucks) and Infomax Optifuel (Renault trucks)

All these systems are supporting drivers:
» before trip (Pre-trip planning)
» after trip (Post trip analysis, providing feedback to the driver on his driving behaviour)

… ITS systems and services mandatory for Electric Vehicles

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Predictive driving: The ADAS Horizon Concept

Extend driver and in-vehicle sensors horizon and allow drivers to ‘see’ around corners

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Application Example: Green Driving

- Route parameters
- Driver parameters
- Traffic parameters
- Environment parameters
- Vehicle parameters

Fuel Consumption

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Green Driving - Digital Map Data

Route parameters
- Number of lanes
- Curvature
- Number of junctions
- Slope
- Speed limit
- Traffic calming measures
- Road class / type

Environment parameters

Vehicle parameters

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Application Example - Dynamic Pass Predictor

More Safety and CO2 Reduction with:

› Sensor data fusion w.r. to a Learning Electronic Horizon, an Enhanced Dynamic Pass Predictor, ACC and Car2X Communication
Application Example: First Use of Digital Map Data to Enhance Fuel Economy

Daimler Trucks North America (Freightliner) Run Smart™ Predictive Cruise Control

• Announced March 2009
• System anticipates road slope profile 2km ahead
• Intelligent speed profile incorporates gravity and momentum in hilly terrain to reduce engine loads

Winner, Telematics Update, Best Commercial Telematics Solution, 2009
Cooperative Systems and Services
Overview
Cooperative Systems and Services

Added value

Reduce impact on environment & increase mobility by:

» exchanging current status data (V2V, V2I)

» cooperative planning & routing system selecting most economical route for truck, while traffic system optimises traffic lights

» adapting traffic signal parameters and other traffic measures so the ensemble of vehicles in the network consumes as little as possible

R&D activities: CVIS, eCoMove

Deployment activities: Freilot
Overall objective

To develop a combination of cooperative systems and tools using V2V and V2I communication to help:

» drivers sustainably eliminate unnecessary fuel consumption,
» fleet managers to provide incentives to drivers to save fuel, and most economical vehicle management
» road operators manage traffic in the most energy efficient way

Target is to reduce by 20% fuel consumption and therefore CO2 emission
Overview

» Coordinator: ERTICO ITS Europe
» Total costs: 22.5 M€  EC contribution: 13.7 M€ (DG-INFSO)
» Starting date: 04/2010  Duration 36 Months
Vision and motivation

Situation today

- Inefficient deceleration
- Wrong gear & engine speed
- Excessive speed, acceleration
- Poor anticipation
- Congestion
- Poorly synchronised signals
- Choice of inefficient route
- Lack of know-how, motivation

Wasted energy due to:

EcoMove Solutions

- ecoSmartDriving
- ecoFreight & Logistics
- ecoTrafficManagement + Control

Residual wasted energy

Energy consumption of “perfect eco-driver”

The future

Energy

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An integrated Green-Mobility approach

Factors
- inefficient route choice
- excess acceleration/speed
- wrong gear/speed choice
- inefficient deceleration
- improvement not sustained
- lack of motivation
- too many stops
- non-optimised signals
- unstable flow, speed too high
- congestion

Theoretical minimum fuel consumption for specific vehicle, driver and journey

eCoMove Integrated Cooperative Systems

Green Routing
- Optimum route from static & dynamic factors
- Map learns from experience

ecoSmart Driving Assistant
- Generate most efficient driving strategy
- Dynamic driving advice via HMI

Post Trip Driving Analysis
- Feedback from “Virtual Trainer”
- Long-term coaching strategy

Measures for Freight
- eco logistics planning
- Training and eco bonus scheme

Adaptive Balancing & Control
- Balanced priority control
- eco green wave
- eco route distribution

eco Motorway Management
- Speed and headway control
- Prioritised ramp metering
- eco merging assistant

eoTraveller support
- Fuel consumption and emission prediction
- eco strategy model

eCoMove Solutions

The future

Residual wasted energy
Theoretical minimum fuel consumption for specific vehicle, driver and journey

eCoMove savings target = 20% of total energy use

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Cooperative data exchange as enabler

**Key**
- ecoFVD: eco Floating Vehicle Data
- ecoTSD: eco Traffic Situation Data
- V2V: Vehicle-to-vehicle
- V2I: Vehicle-to-infrastructure

**eco-driving support**
- Green Routing
  - Optimum route from static & dynamic factors
  - Map learns from experience
- ecoSmart Driving Assistant
  - Generation of the most efficient driving strategy
  - Dynamic driving advice via HMI
- Post Trip Driving Analysis
  - Feedback on driving behaviour
  - Long-term coaching strategy
- Freight specific measures
  - Eco logistics planning
  - Training and eco bonus scheme

**eco-traffic management and control**
- Adaptive Balancing & Control
  - Eco green wave
  - Balanced priority control
  - Eco route distribution
- Eco Motorway Management
  - Prioritised ramp metering
  - Eco merging assistant
  - Speed and headway control
- Eco traveller support
  - Fuel consumption and emission prediction
  - Eco strategy model

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Overall concept

“Real-time coordination of individual drivers and infrastructure”
Core Technologies

» eCoMove communication platform
» eCoMove messages

» An **ecoMAP** comprising a **digital map database** enhanced with additional **attributes needed for eco-driving support**, such as slope, historical speed profile and **energy consumption data**;

» A **situational operational model** used for eCoDriving support and transport strategy analysis, taking account real area-wide energy use and specific energy “hot-spots”.

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eCoSmartDriving application overview

- eInfo from traffic centres & infrastructure (V2I)
- eInfo from other vehicles (V2V)
- Green routing (route with lowest fuel consumption)
- eco Cooperative Horizon (vehicle path prediction including eco attributes)
- eco driving profile (e.g. speed, acceleration, gear, ...)
- ecoInformation
- eco driving support
- dynamic eco routing
- ecoHMI
- ecoMaps with eco attributes

- Car/driver specifics
  - Positioning
    - car fuel consumption profile / other in car info & sensors
  - driver preference & driving tasks
  - personal driving storyboard & learning maps

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Eco driving challenges

- Effects of traditional eco driving training wear off over time
- Sustainable ecoDriving via adaptive coaching and incentives
ecoAdaptive Balancing and Control

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Standardisation as key enabler
Conclusion

» **Keyword are prediction and connectivity enabling:**
  › better management of fuel consumption
  › more efficient use of transport means
  › overall cost reduction

» **Realtime driver coaching has the highest potential to reduce fuel consumption**

» **Cooperative solutions can reduce fuel consumption across road transport**

» **Core cooperative technology were developed in key projects like CVIS, Safespot and Coopers**
Conclusion

» eCoMove extends these developments to energy efficiency and CO$_2$ reduction with a complete integrated approach based on cooperative technology

These results will directly influence driver behaviour towards eco driving in a sustainable way

Paradox

all proposed measures => increase traffic fluidity...
... leading to more vehicles entering traffic ...
=> we need to reinvent our mobility

ITS is the solution
Thank you for your attention

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