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Intelligent Car Management Application for Advanced Green Road Transport Services

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Presentation Structure

- Motivation
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- The CARMA Vision
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- Proposed Functionalities
- Holistic approach for traffic data acquisition
- CARMA Functionalities
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- Q&A

Motivation

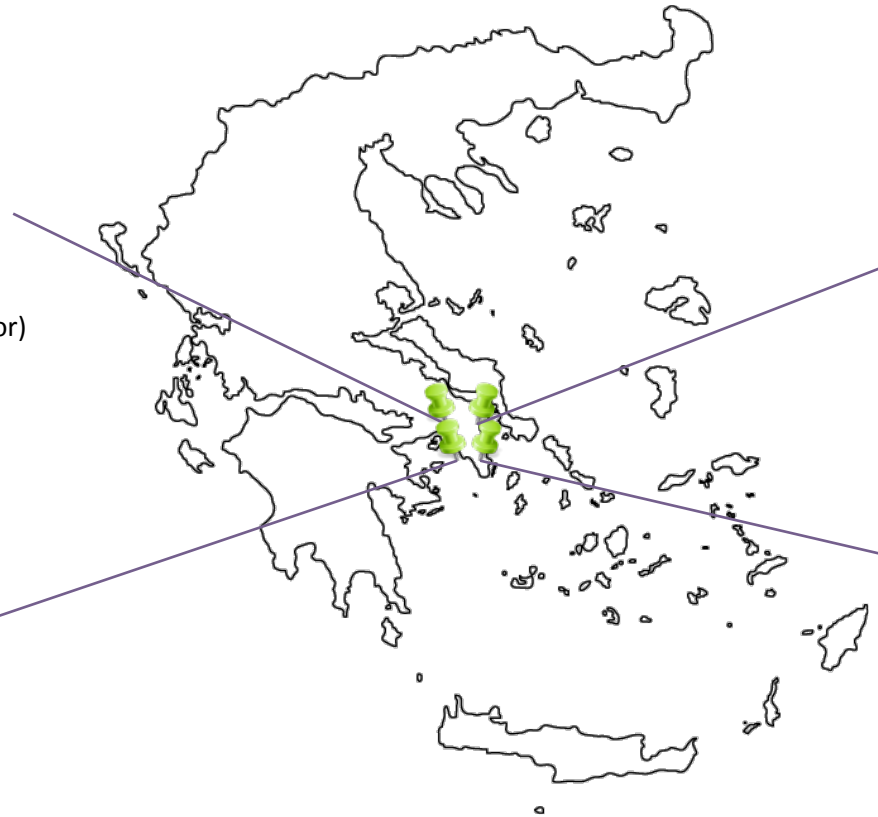
Issues encountered in road transportation:

- traffic congestion
- road accidents
- lack of parking space
- difficulties in using environmentally friendly means

Economic and social impact:

- high loss of man-hours
- atmospheric and acoustic pollution
- increase in energy consumption
- increase in road accidents
- operational difficulty of public means of transportation

The CARMA project



Vodafone Greece
(Mobile Network Operator)

Attikes Diadromes
(Road Network Operator)

Zelitron
(Fleet Services)

Institute of Communication
and Computer Systems
(Research Institute)

The CARMA Vision

Vision:

- To build an innovative and comprehensive ICT system for supporting and promoting green daily commuting habits.
- To assist drivers in saving on fuel expenses, time and GHG emissions on a regular basis.
- To produce a green decision support system
  - assist drivers in making the best road commute choices, both pre-trip and post-trip

Eventually, CARMA will result in an advanced and green ICT system that will be commercially exploitable by:

- mobile network operators
- mobile service providers
- road network operators
- public authorities

State-of-the-art

- Driver assistance systems:
  - Eco-driving systems
    - Developed by vehicle manufacturers
  - Eco-routing systems
    - Developed by vehicle manufacturers
    - Third-party aftermarket systems

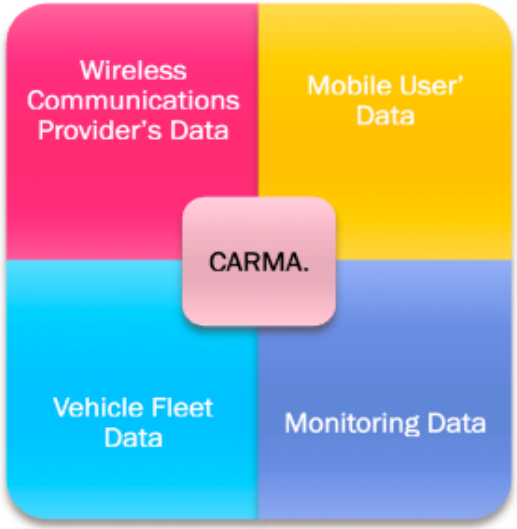
Proposed Functionalities

- Holistic approach for traffic data acquisition
- Intelligent and advanced traffic data fusion
- Provision of reliable feedback information
- Advanced green routing decision support system
- Smart and efficient computation of usage patterns
- User privacy assurance
- Engineering of a comprehensive ICT system implementing the proposed functionalities
- Validation of the engineered system in laboratory and field trials

All in a simple, all-inclusive application!

Holistic approach for traffic data acquisition

- Exploitation of multiple and heterogeneous traffic data sources
  - anonymous bulk location & transition data
    - provided by mobile network operators
  - mobile end-user data
    - gathered from drivers with CARMA app on their mobile device
  - fleet data
    - from on-board devices of fleet vehicles
  - legacy road traffic monitoring data
    - vehicle detection induction loops
    - CCTV systems
    - …



CARMA Functionalities 1/3

- **Intelligent and advanced traffic data fusion**
  - Provision of comprehensive and reliable traffic information
  - Production of reliable traffic prediction
    - Machine-learning techniques for the exploitation of:
      - historical (past) traffic data
      - real-time (recent) traffic data

- **Provision of reliable feedback information**
  - Development of an application that informs the driver on the amount of fuel, money, time and CO2 he has spent during a road trip.
    - Web-based application
    - Mobile terminal application
  - Calculation based on a series of parameters:
    - travel distance & time
    - vehicle speed & acceleration
    - terrain info
    - etc…

CARMA Functionalities 2/3

- **Advanced green routing decision support system**
  - Assistance in discovery and identification of energy efficient routes
    - Development of an application that accurately **predicts** fuel/money/time/ CO2 consumption of possible **alternative routes** towards the desired destination.
    - Consideration of collected traffic knowledge

- **Smart and efficient computation of road usage patterns**
  - Development of a comprehensive tool for calculating origin & destination (O-D) matrices for an entire urban area or road network.
  - Analysis and visualization of traffic flows nature and distribution between entrance and exit points. → Enables road operators to make overall adjustments in order to globally improve time efficiency and fuel conservation.

- **User privacy assurance**
  - Anonymization of user data collected and shared
  - Ability of the user to deactivate or temporarily pause sharing and collection of terminal data.

CARMA Functionalities 3/3

- **Engineering of a comprehensive ICT system implementing the proposed functionalities**
  - Terminal-side and server-side services and applications
  - Test vehicles
  - End-user mobile terminals
  - Variable Message Signs (VMSs)
  - Mobile Network Infrastructure

- **Validation of the engineered system in laboratory and field trials**
  - Laboratory trials
  - Field trials
    - within the National Technical University of Athens campus
      - focused small-scale system testing in controlled, accident-free environment
    - road network operated by Attikes Diadromes (largest highway in Athens)
      - main test site with real-world conditions

Use Cases

- Pre-trip planning
  - Comparison and evaluation of candidate alternative routing options for the driver

- Post-trip feedback
  - Feedback on amount of fuel/time/money/CO_2 actually spent, in contrast to candidate alternative routing options

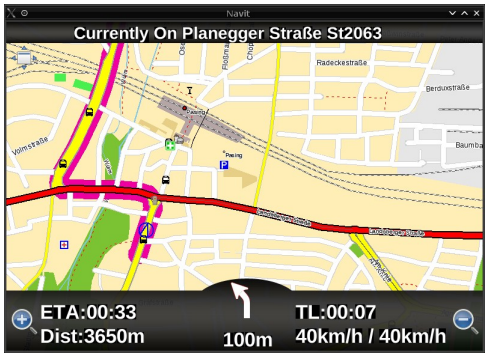
Presentation of comparative results either:

- on mobile devices
- on the web

Provision of answers to questions such as:

- Which is the most energy efficient route to choose: An avenue, a motorway, a ring road, a conventional in-city route, a set of large avenues, a set of local streets; a route with or without tolls?
- How much more/less would have I spent if I had chosen another route?

Results & performance evaluation



- Initial platform setup for the on-board CARMA application
  - Samsung Galaxy S smartphone
    - 1GHz single-core processor
    - 512MB of RAM
    - Android 4.2.2
  - Customized edition of the Navit navigation software
    - Enhanced to use machine-learning calculated costs for routing
    - Implementation of artificial neural networks

Segments evaluated	Total time [sec]	Scoring time [sec]	Total rate [segments/sec]	Scoring rate [segments/sec]
69522	86	2,204	808	31544
148032	175	4,695	846	31530

Thank you for your attention!

Any questions?

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Project Website:
www.carma-project.gr

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ΕΣΠΑ 2007-2013
Υπουργείο Παιδείας και Θρησκευμάτων
ΕΥΔΕ-ΕΤΑΚ
Ε. Π. Ανταγωνιστικότητα και Επιχειρηματικότητα (ΕΠΑΝ ΙΙ), ΠΕΠ Μακεδονίας – Θράκης, ΠΕΠ Κρήτης και Νήσων Αιγαίου, ΠΕΠ Θεσσαλίας – Στερεάς Ελλάδας – Ηπείρου, ΠΕΠ Αττικής