



Smart Travelling Use Case

CERBERO

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TNO



Content

- CERBERO partners involved
- Smart Travelling Use Case
- Driving Simulator
- CRF facilities



TNO

<https://www.tno.nl/en/>

- Dutch Organization for Applied Scientific Research
- Involved TNO departments in CERBERO:
 - **Power Trains** > Models for Electric Vehicles
 - **Distributed Sensor Systems** > CPS and model based design
 - **Monitoring Control Services** > Large scale CPS architecture and design



<http://www.abinsula.com/en/>

- Software company developing IoT and Embedded software, including automotive and infotainment systems (relevant for the Travelling Use Case)



<http://www.stcorp.nl>

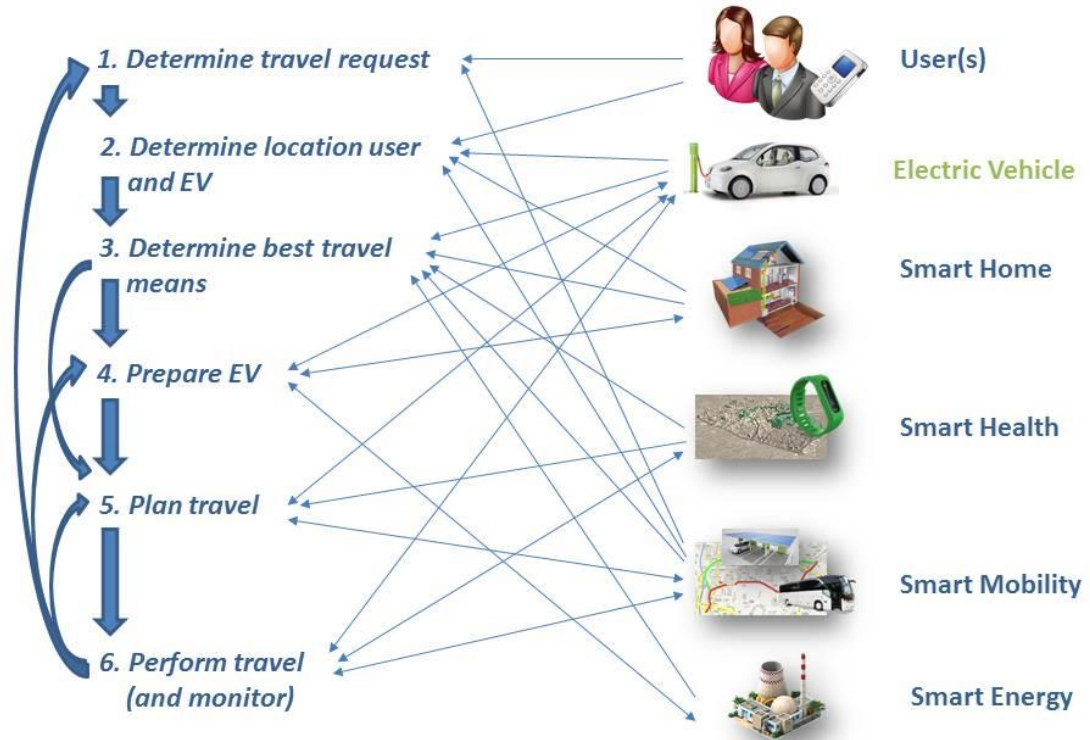
- Dutch software company: Sensing and Control Systems, Scientific Data Processing, Intelligent Software Applications, Technical Consulting
- CERBERO: Develop intelligent driver support solution Electric Vehicle

Activities CRF team (involved in CERBERO):

- Design of **advanced interaction logics for innovative in-vehicle systems**, in order to guarantee an optimal User Experience:
 - Infotainment HMIs
 - ADAS HMIs
 - Ecodriving HMIs
- Develop HMI for innovative ADAS systems
- Develop methods to understand and analyze driver behavior
- Develop methods to understand and analyze distraction and workload
- Perform user research to identify HMI requirements that consider users' needs
- Perform user research to collect Voice Of Customer on Ergonomics and HMI relevant topics

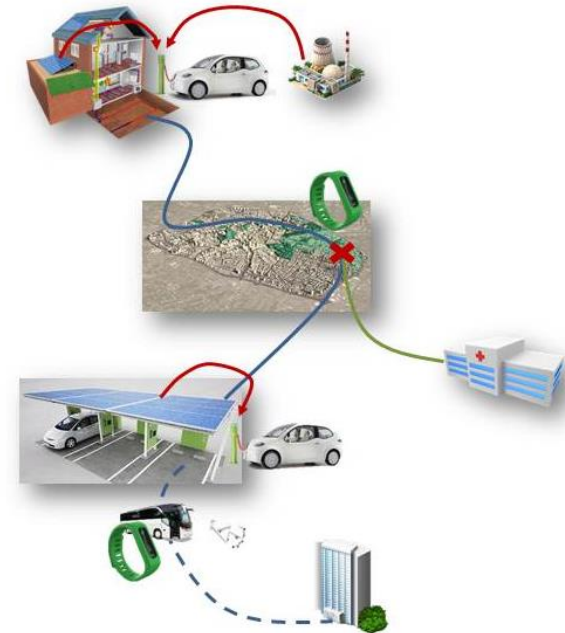


Smart Travelling



Smart Travelling Use Case

- System will need to provide and process multiple travelling scenarios
- Focus on interaction between human and the Electric Vehicle
- Scenarios should involve:
 - **predictions** (e.g. on power and trip)
 - **autonomy** (from the car point of view)
 - **adaptation** (given changed circumstances)

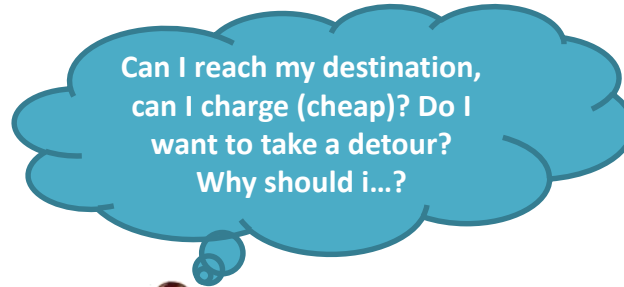


Multi Objective



Electric Vehicle

- Accurate range estimation based on **User** Driving Behaviour, Predicted Destination, Predicted Route.
- EV **Charge stations** availability
- Appropriate Pre-Conditioning



User(s)



Smart Mobility

- Reduced traffic congestion



Smart Home

- Use **EV** energy when available

Optimize travel costs

- Fast (full) charge: **Best scenario to reach destination vs. battery degradation, possible high elec. price.**
- Slow (partial) charge: **Make use of off-peak energy prices. vs risk in uncertainty in schedule / EV range**

Optimize travel & charging time.

- EV **Charge station** availability on route & destination

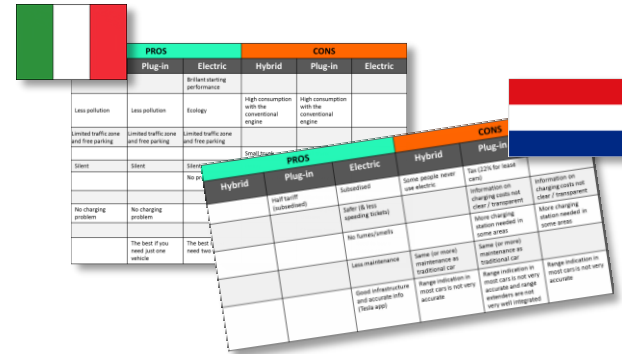


Smart Energy

- Grid balancing; communication with **Charge stations**

Focus group sessions

- Collected concrete issues of EV drivers
- Collected suggestions for future improvements
- Country differences
 - E.g. Italian drivers only use EV for short trips in the city while Dutch drivers use EV for both short and long trips (difference of charging infrastructure seems to influence behavior)
- Results are used to define use case scenarios containing most relevant driver issues (enabling CRF to perform most relevant MHI analysis and innovation for Electric Vehicles)

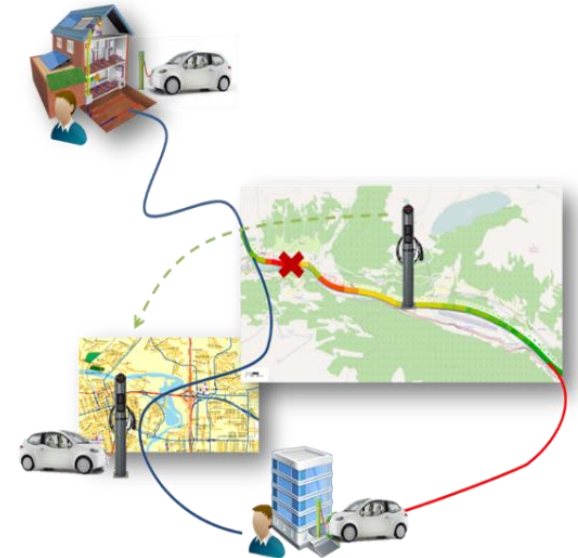


	PROS			CONS	
	Plug-in	Electric	Hybrid	Plug-in	Electric
Less pollution	Less pollution	Ecology	High consumption with the conventional engine	High consumption with the conventional engine	
Limited traffic zone and free parking	Limited traffic zone and free parking	Limited traffic zone and free parking			
Slow	Slow	Slow			
No charging problem	No charging problem	No charging problem			
The best EVs need just one vehicle		The best EVs need just one vehicle			

	PROS		CONS	
	Hybrid	Plug-in	Hybrid	Plug-in
	Subsidized	Subsidized	Some people never use electric	Top 122% for leased cars
	Full fuel (conventional)	Full fuel (conventional)	Information on charging cables not clear / transparent	Information on charging cables not clear / transparent
	Full (30 km (standing still))	Full (30 km (standing still))	No charging station needed in some areas	More charging station needed in some areas
	No fumes/smells	No fumes/smells		
	Low maintenance	Low maintenance	Same (or more) maintenance as traditional car	Same (or more) maintenance as traditional car
	Good infrastructure and accurate info (like way)	Good infrastructure and accurate info (like way)	Range indication in most cars is not very accurate and range extenders are not very integrated	Range indication in most cars is not very accurate

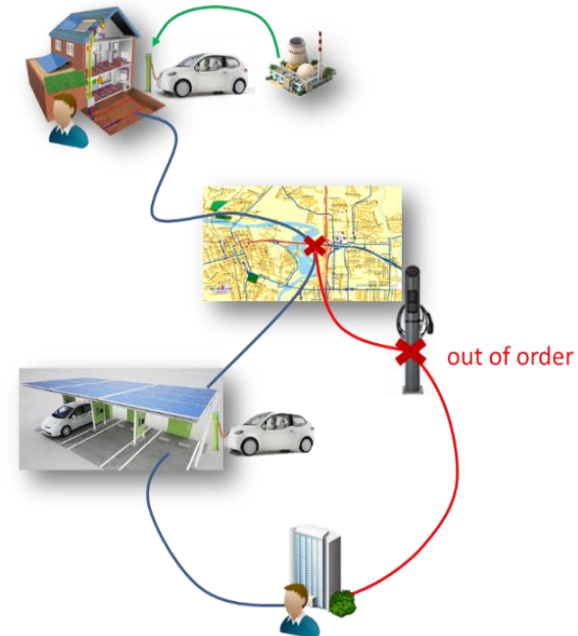
Use Case scenario: Urban trip

- Issue: problems with battery charge can arise if a rerouting is needed for some reasons:
 - sudden congestion
 - unforeseen event (e.g. sudden family commitment, scheduled agenda change...)
- Recovery scenario: switch off on-board devices (e.g. air-conditioning, radio...)



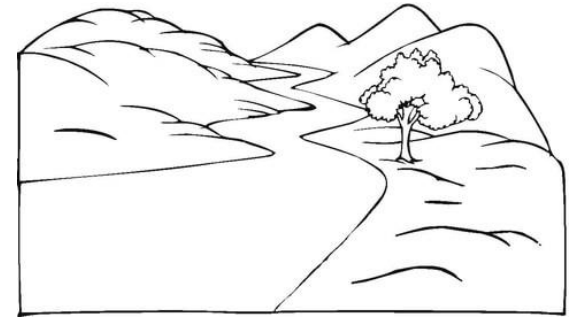
Use Case scenario: Highway trip

- Issue: problems with battery charge during the trip if:
 - there are no charging station at a regular distance
 - the planned charging station is out of order
 - the charging time is long and slow (need to do longer stops during the journey than the scheduled ones)
- Recovery scenario: plan the trip very carefully (calculate alternatives) before starting



Use Case scenario: Up-hill trip

- Issue: problems with enough vehicle power to climb and to climb in a safe way with the current battery charge
- Recovery scenario: plan the trip very carefully (calculate alternatives) before starting



Requirements derived from the use cases

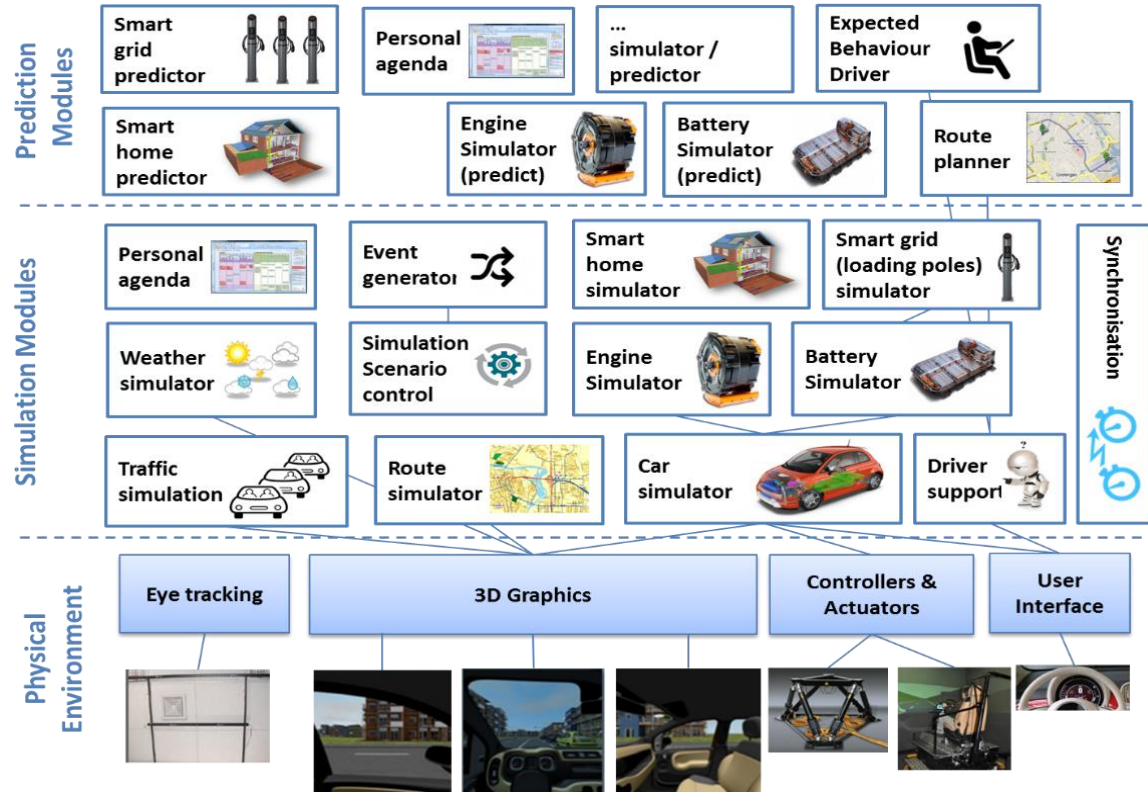
Functional:

- Battery capacity management
- Battery charging strategy
- Determine availability of charging poles
- Manage cost of charging
- Plan route
- Adaptability of route
- User advice and preferences
- User interaction

Non-Functional:

- Real time simulation
- Adaptability simulator
- Reusable simulation modules
- Simulation with system in the loop

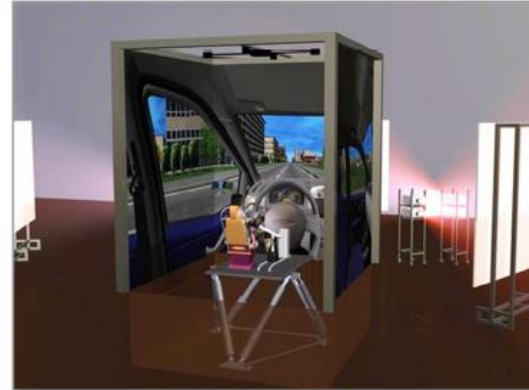
Driving Simulator



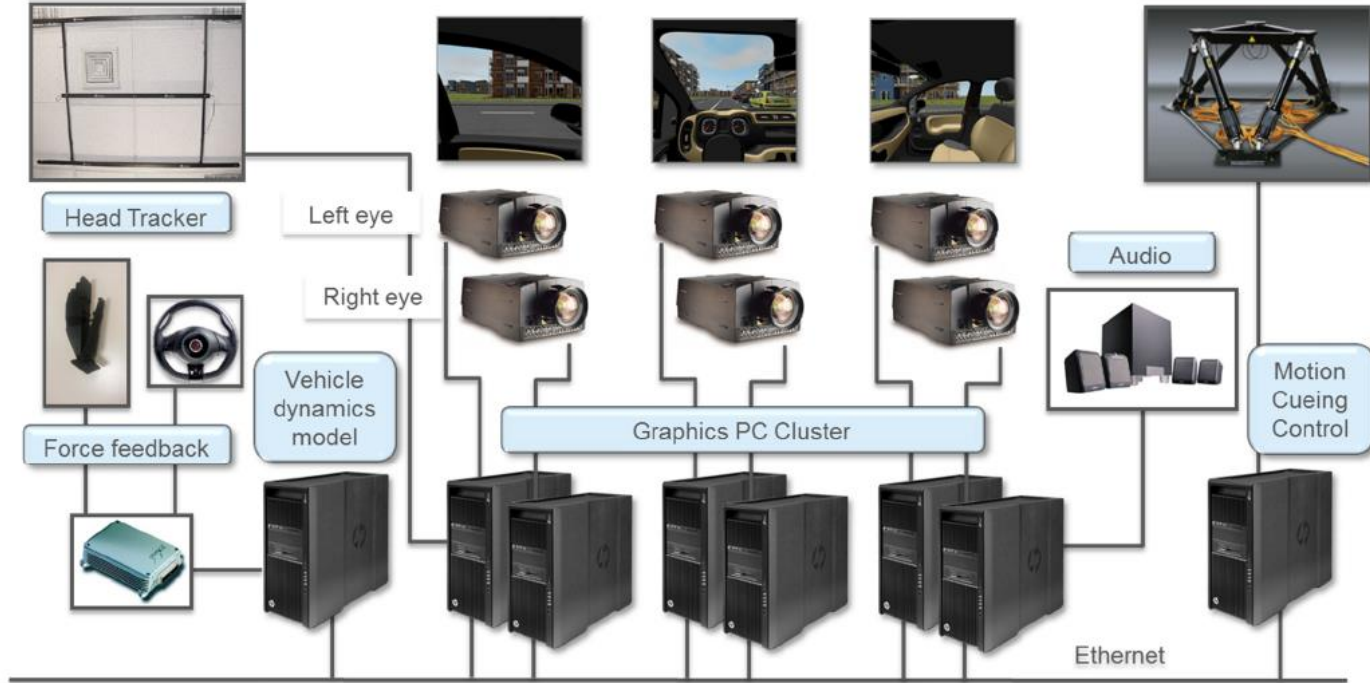
CRF Facilities: High End Immersive Driving Simulator

Features:

- Immersive 3D vision of interiors
- Dynamic cueing
- Active feedback on primary controls
- Realistic vehicle dynamics model
- Parametric mock-up
- Spatial audio
- Programmable environment with traffic, pedestrians, crossroads etc.



CRF Facilities: High End Immersive Driving Simulator





<http://www.oktal.fr/en/automotive/range-of-simulators/software>

SCANer™ studio : Driver component

- Human Driver
 - Steering and pedals
 - Multi-Visualization (stereo, synchro, multi-channel)
 - Sound (Inside car and environment)
- Tracker
 - Eye,
 - Head,
 - Video recording





<http://www.oktal.fr/en/automotive/range-of-simulators/software>

SCANer™ studio : Environment component

- Traffic (Intelligent and autonomous)
 - Multi-agent traffic and realistic vehicle behavior
 - mobiles types: various terrestrial vehicles and Pedestrians.
 - Collision detection , Left/right driving.
 - Involved a large number of vehicles (up to 200 vehicles)
 - Add-on for external micro simulation traffic software
- Terrain and Road infrastructure
 - Recreate a road network drastically faster as usual tools
 - Design and generate 3D and logical road network with civil engineering approach
 - From scratch, from existing 3D databases or from GIS data (geo-specific environment)

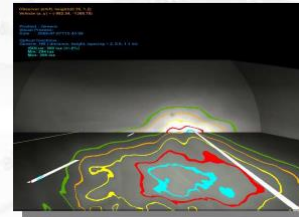
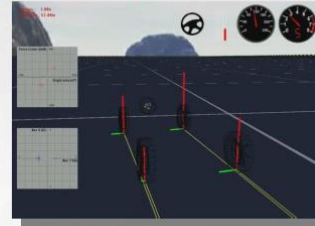




<http://www.oktal.fr/en/automotive/range-of-simulators/software>

SCANeR™ studio : Vehicle component (1)

- Vehicle dynamics:
 - Vehicle conception (from pilot studies to final setup on track),
 - Homologation tests,
 - Accident reconstruction,
 - Road / vehicle compliance test,
 - Advanced chassis control,
 - Compare simulation to measurement,
 - Co-simulation,
 - Real time driving simulator
- Headlight Control:
 - Photometric rendering using illumination map from physical goniometer scanned or from virtual design data .
 - Reflective material rendering
 - Relative visual comparison of night driving
 - Evaluation and validation of AFS
 - Interactive measurement





<http://www.oktal.fr/en/automotive/range-of-simulators/software>

SCANer™ studio : Vehicle component (2)

- Cockpit interiors
 - CAD import data
 - Mirror reflexion
 - Cockpit animation (needle, steering...)
- Sensors (ADAS)
 - Optical / Infrared
 - Intelligent transportation system test

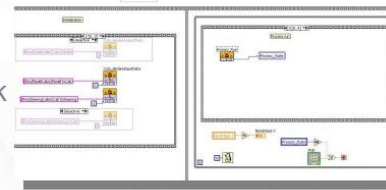




<http://www.oktal.fr/en/automotive/range-of-simulators/software>

SCANer™ studio : Simulation component

- Analyzing
 - Graph data
 - Video replay
 - 3D environment, camera view...
- SDK
 - C++ API (Network and SHM)
 - ROADXML API
 - Visual plugin API
 - Labview® and Matlab® Simulink interface



END

(Questions ?)



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