Smart Travelling Use Case

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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

CENTRO RICERCHE FIAT

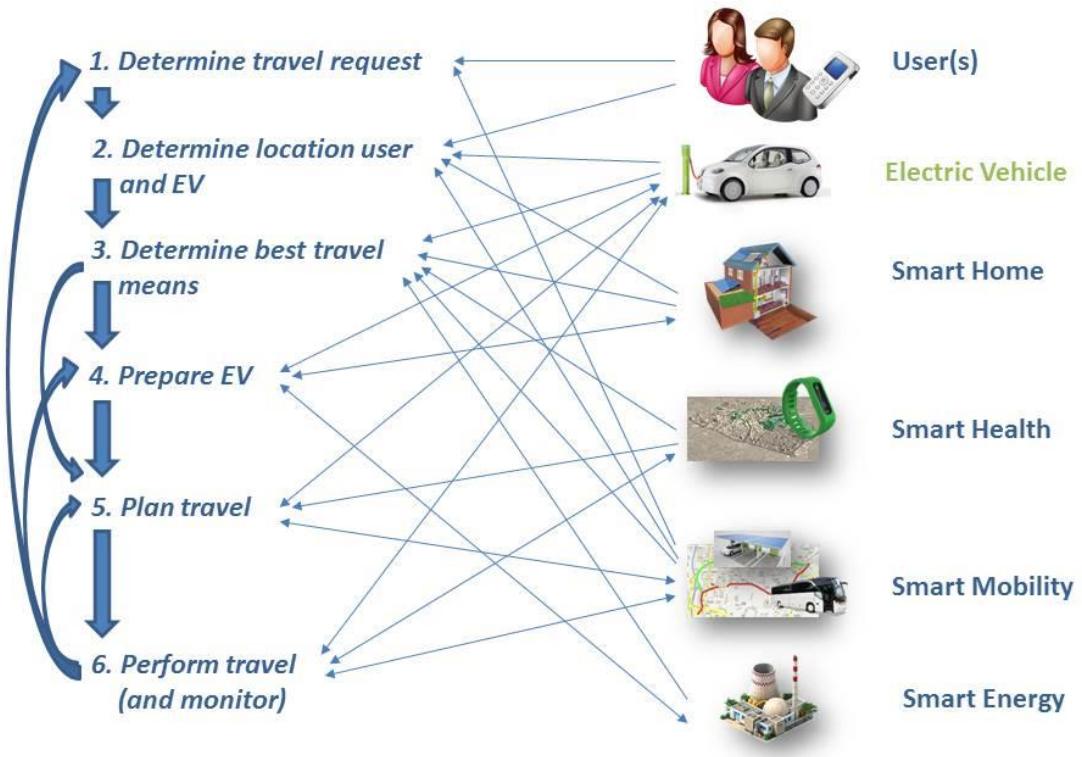
https://www.crf.it/EN

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

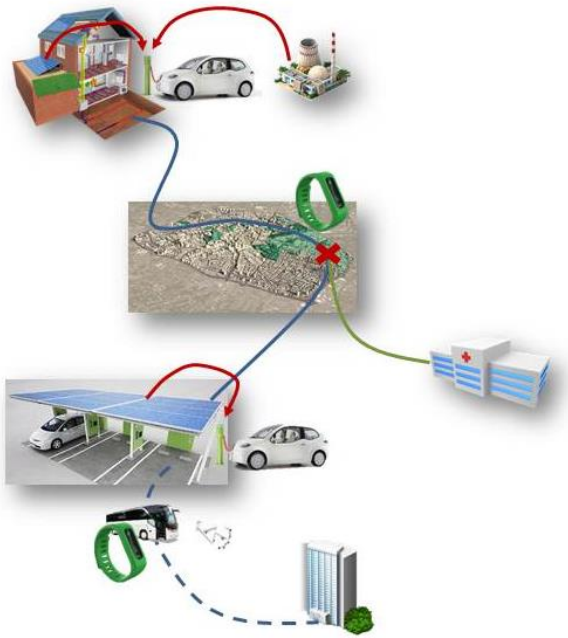
- Develop HMI for innovative ADAS systems
- Develop methods to understand and analyze driver behavior
- Develop methods to understand and analyze distraction and workload
- Perform user research to identify HMI requirements that consider users' needs
- Perform user research to collect Voice Of Customer 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

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.

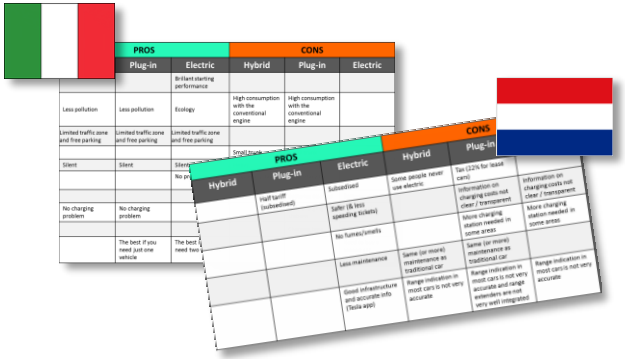
- EV **Charge station** availability on route & destination

Smart Energy

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

Focus group sessions

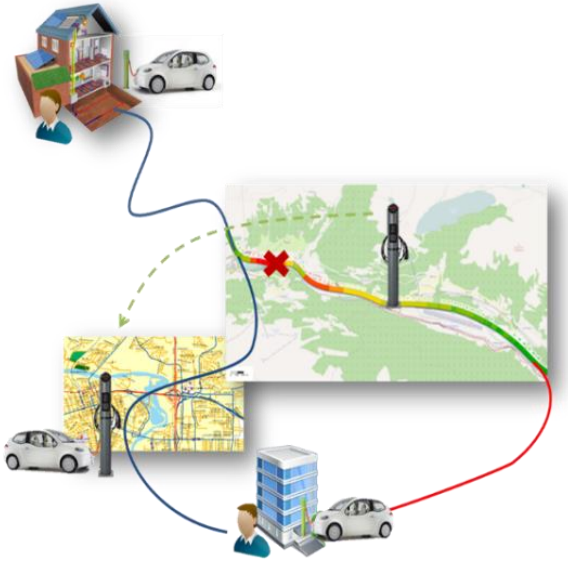
- Collected concrete issues of EV drivers
- Collected suggestions for future improvements
- Country differences
  - E.g. Italian drivers only use EV for short trips in the city while Dutch drivers use EV for both short and long trips (difference of charging infrastructure seems to influence behavior)
- 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)



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 committment, scheduled agenda change…)

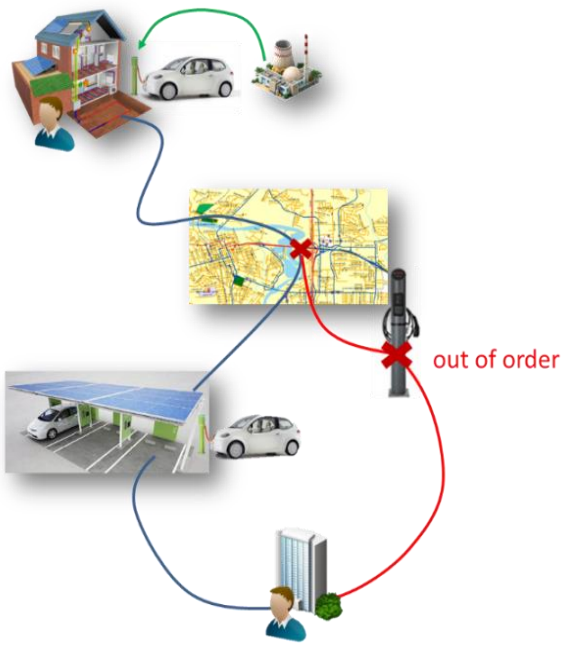
- Recovery scenario: switch off on-board devices (e.g. air-conditioning, radio…)



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)

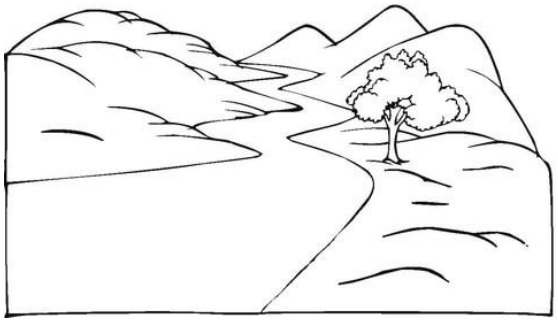
- Recovery scenario: plan the trip very carefully (calculate alternatives) before starting



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

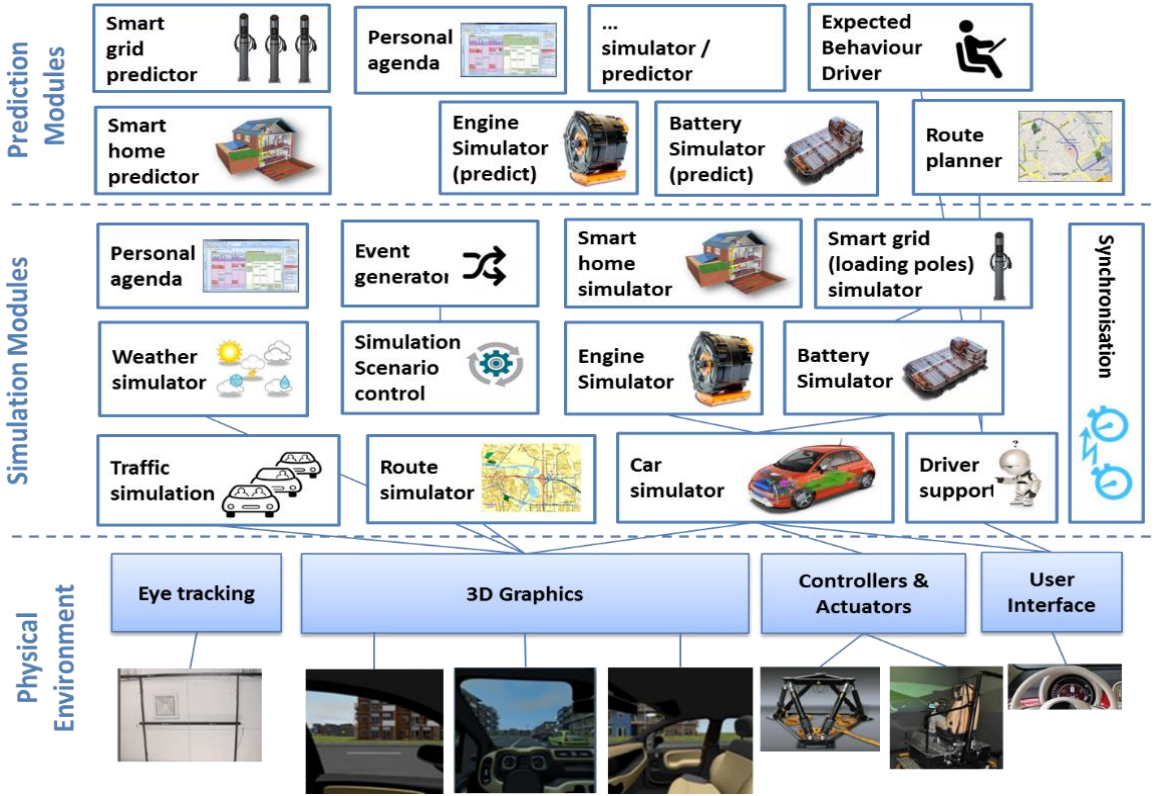
Functional:

- 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

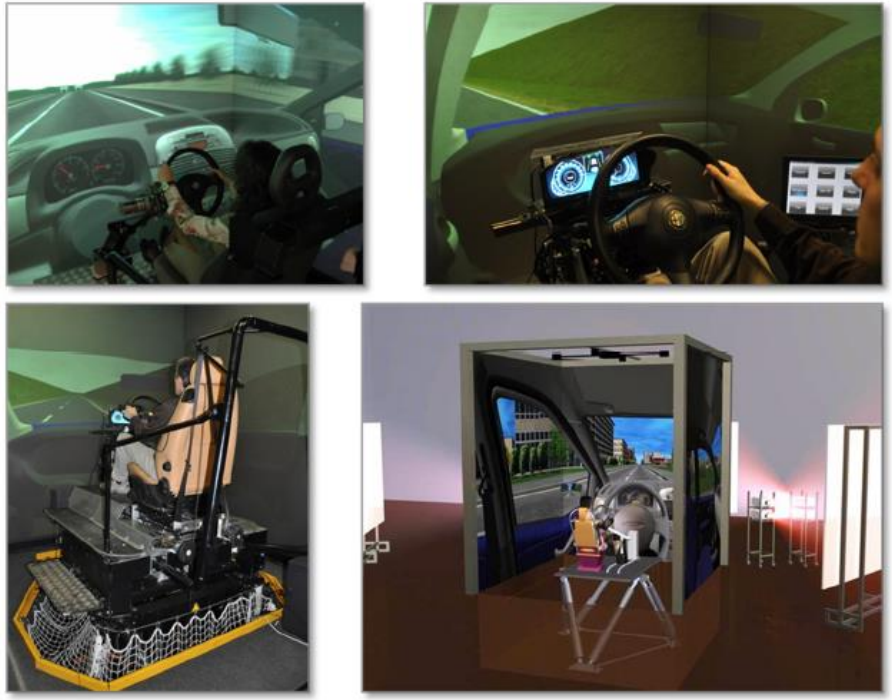
Driving Simulator



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.



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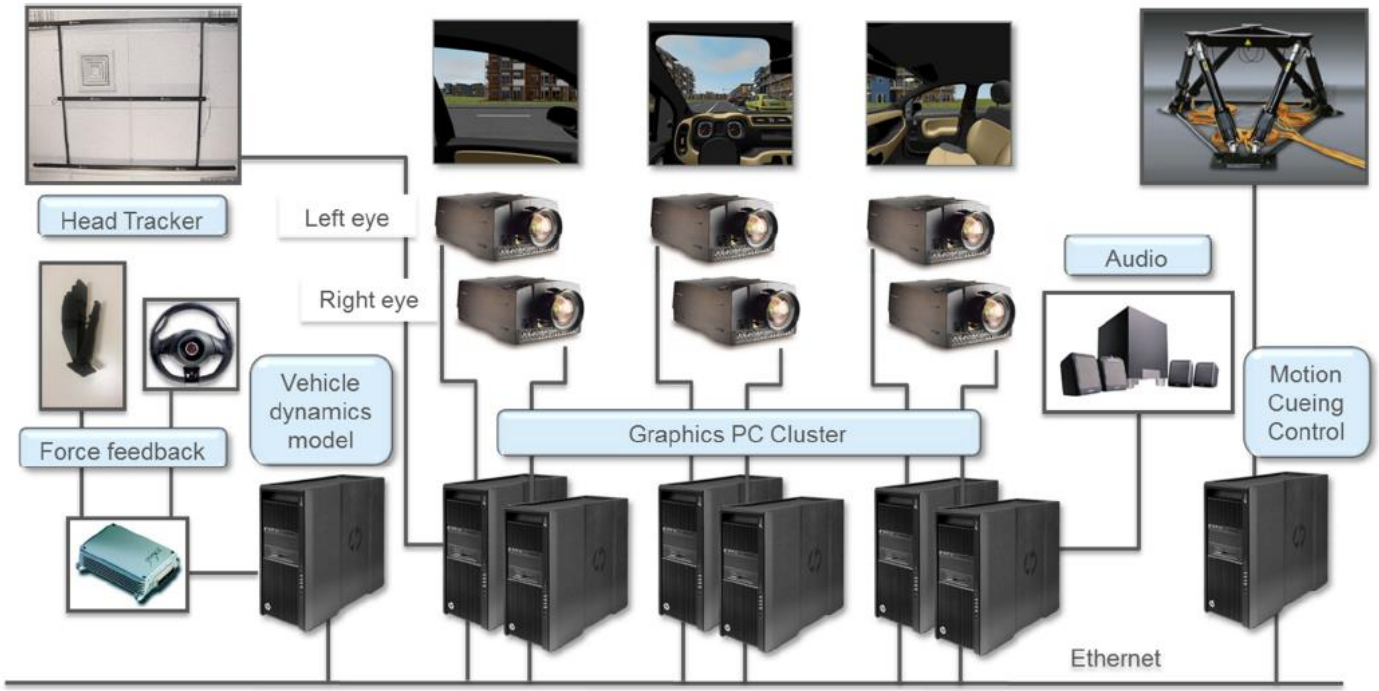
CRF Facilities: High End Immersive Driving Simulator



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

SCANeR™ studio
Simulation Engine

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)

OKTAL

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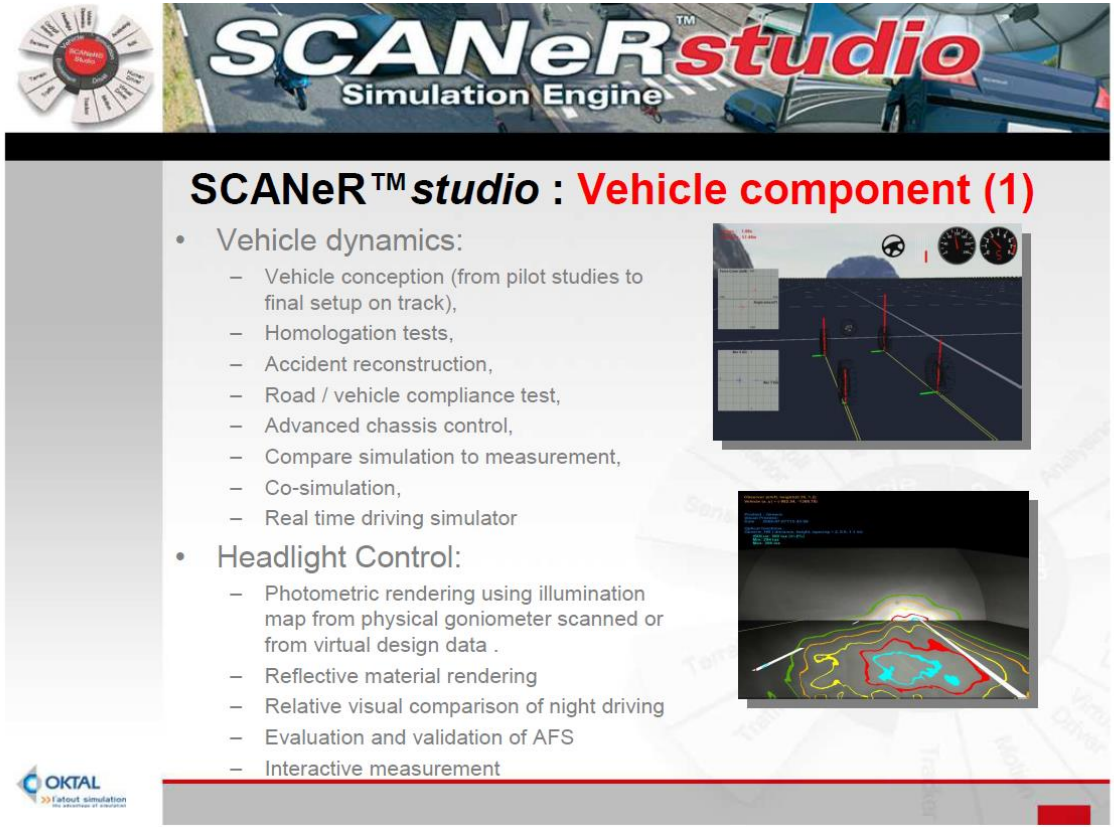

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SCANeR™ studio
Simulation Engine

SCANeR™ *studio* : Vehicle component (2)

- Cockpit interiors
  - CAD import data
  - Mirror reflexion
  - Cockpit animation (needle, steering…)

- Sensors (ADAS)
  - Optical / Infrared
  - Intelligent transportation system test

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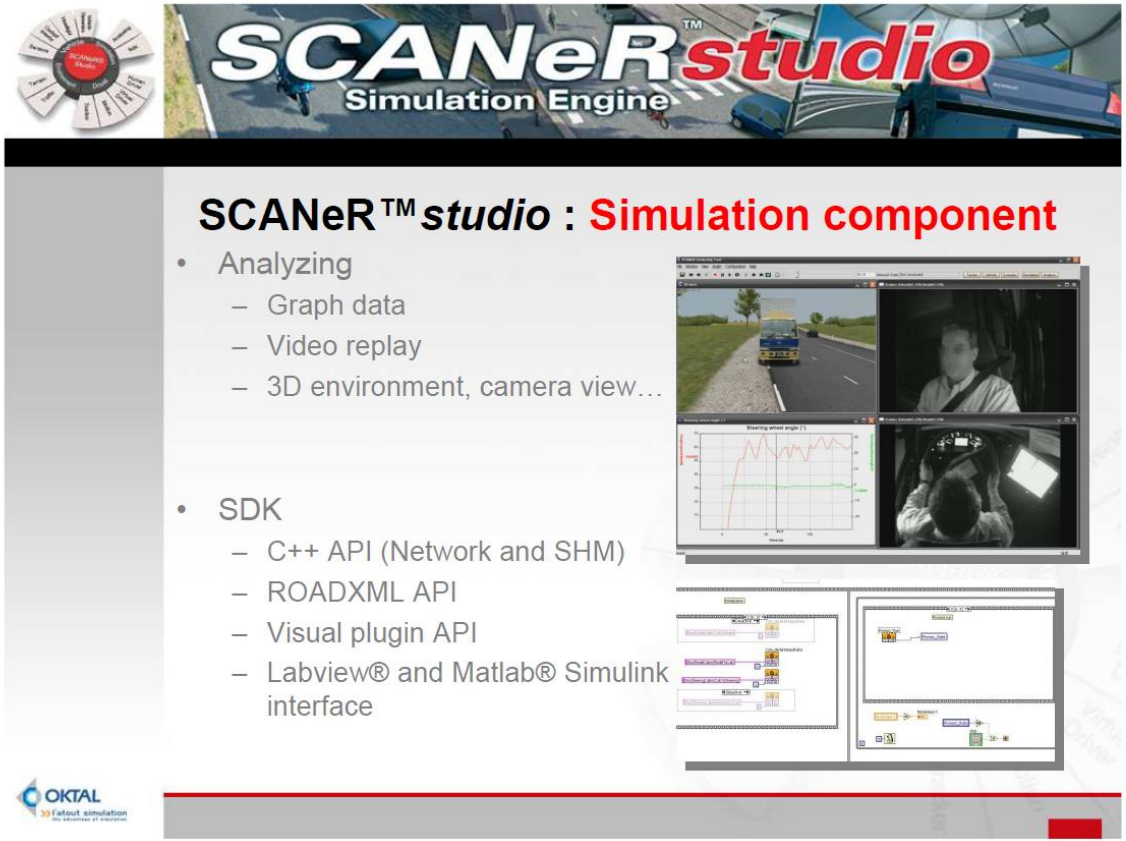

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(Questions ?)