Driver-Vehicle-Environment monitoring modules

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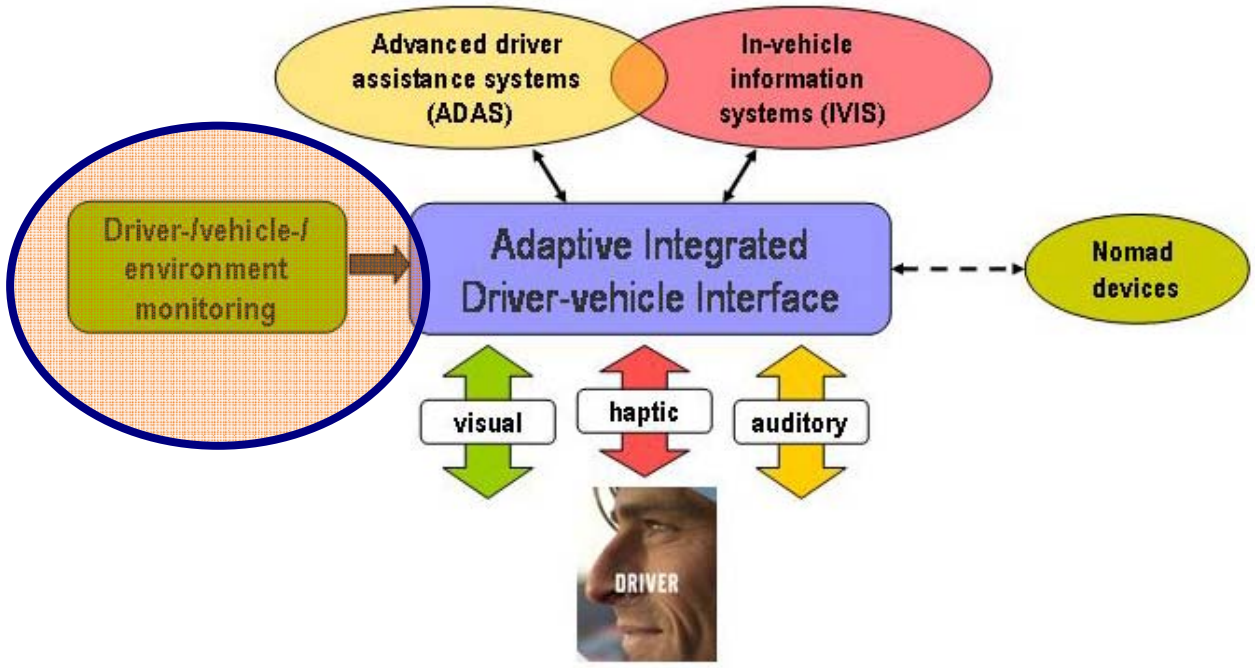
AIDE Driver – Vehicle – Environment module: the problem that addresses

The objective is to develop techniques for real-time monitoring of the driver-vehicle-environment state, in order to enable real-time adaptation of the driver – vehicle interface.



DVE detected conditions

DVE parameter	Explanation
Driving demand	Driver's "level of availability" to receive and process information, according to the requirements of the current driving task (not available ⇔ high driving demand).
Driver Distraction	Cognitive load or shift of visual attention away from the road ahead, induced by an external event or a secondary task.
Driver impairment	The physical ability of the driver to drive (fatigue, sleepiness, etc.).
Driver intent	The driver's intention, e.g. for a lane change.
Traffic and environmental risk	The total level of risk concerning the environmental and the traffic conditions (environment type, traffic density, environmental conditions etc.).
Driver profile	A stored user profile combined with a user's driving record in terms of user's preferences and driving behaviour.

Functional architecture of DVE modules

DVEM

CAA module

Driver's Cockpit activity assessment + detection of driver intention

DAE module
Driver's availability assessment with respect to the primary driving task

DSD module
Driver's physiological and behavioural diagnostic

TERA module
traffic and environment risk assessment functions + detection of driver intention

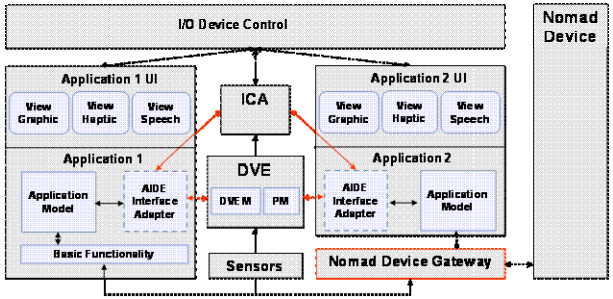
DVE component

PM

Profile data

DC module
Driver's characteristics and preferences parameters

Sensor array



Sensor definition and adaptation

Sensor array

Inertial
Vehicle state
BUILT-IN
CAN bus

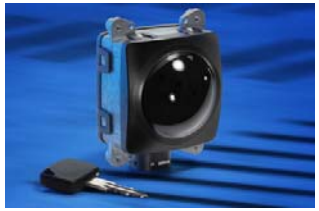
Radar Laser Scanner
object list
BUILT-IN

Frontal Camera
Lane
BUILT-IN

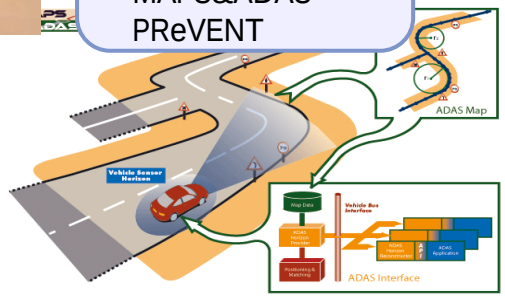
Camera based Eye tracking

AIDE Maps interface

Eye gaze and head position stereo vision

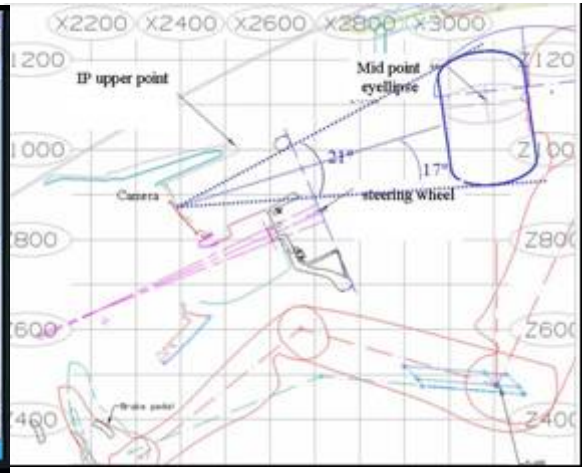


GPS, gyro and digital maps
Synergies with MAPS&ADAS PReVENT

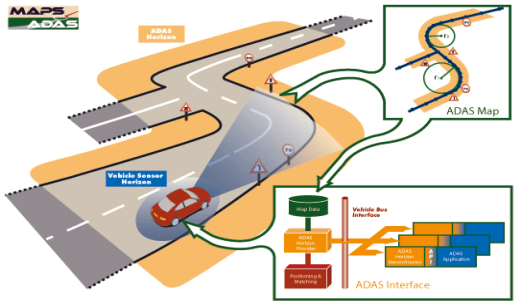


Eyelid sensor

- The Eyelid sensor is a vision based system which processes the video flow of the driver's face to provide the eye opening and blink behaviour signals.
- Physically the sensor is composed of a camera including a set of pulsed near infrared (NIR) LEDs placed in the instrument panel linked to a laptop which processes the image flow provided by the camera.

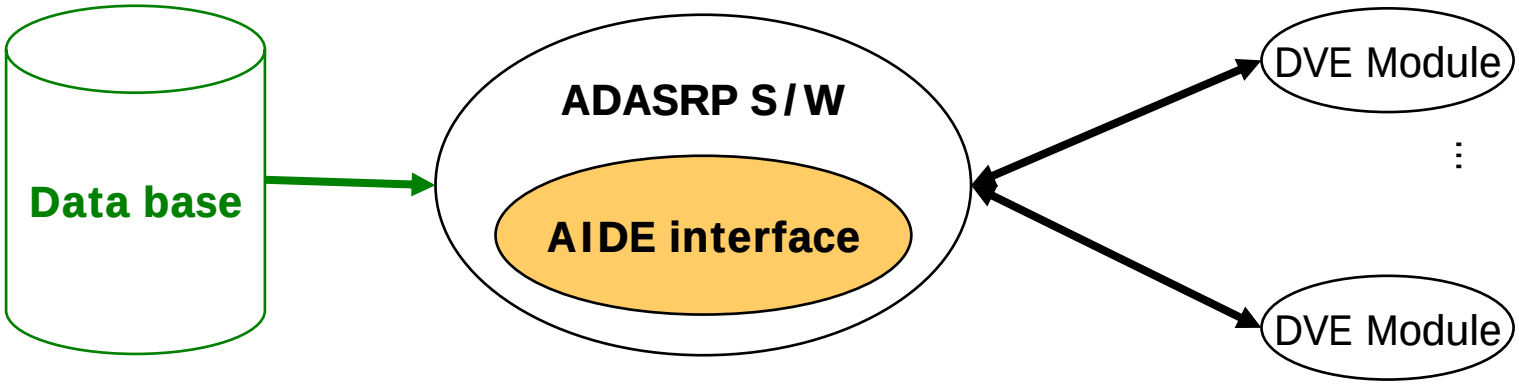


Map data extraction

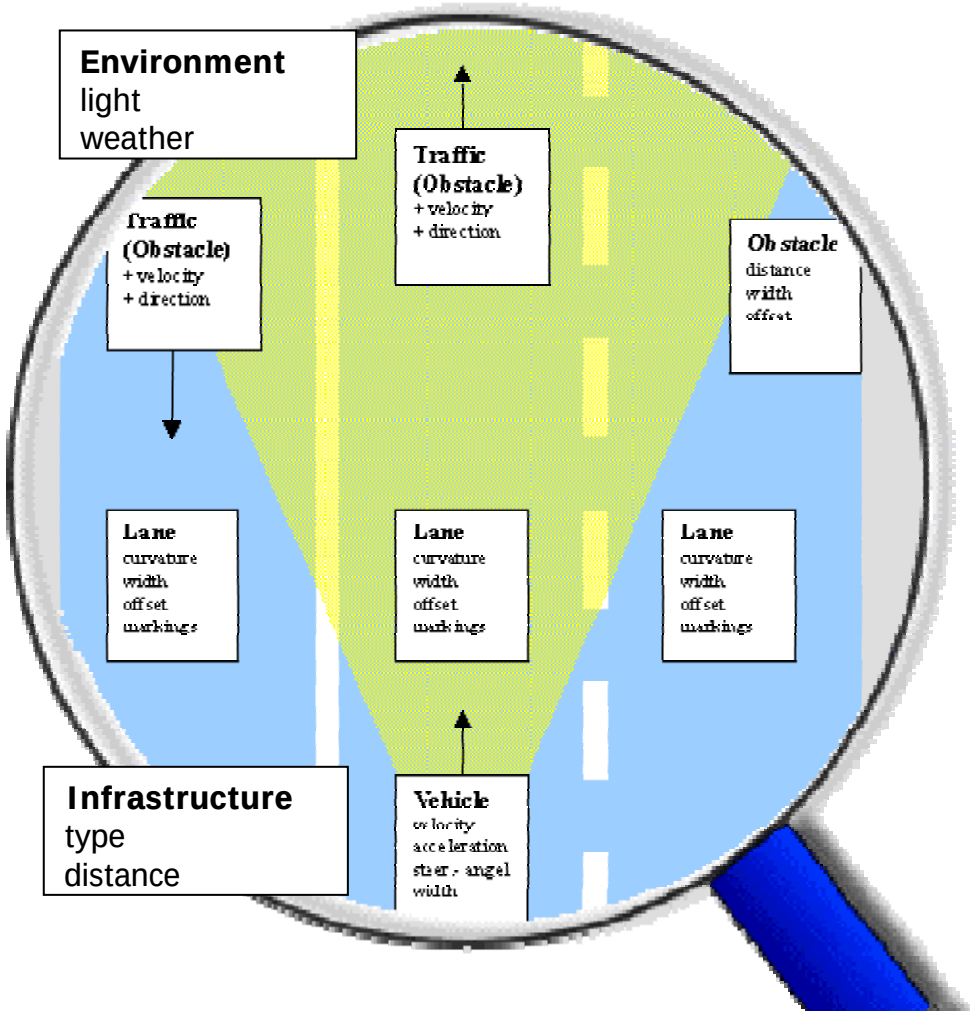


MAPS Attributes

Segment | Crossing | Traffic Sign | Speed limits | Curvature



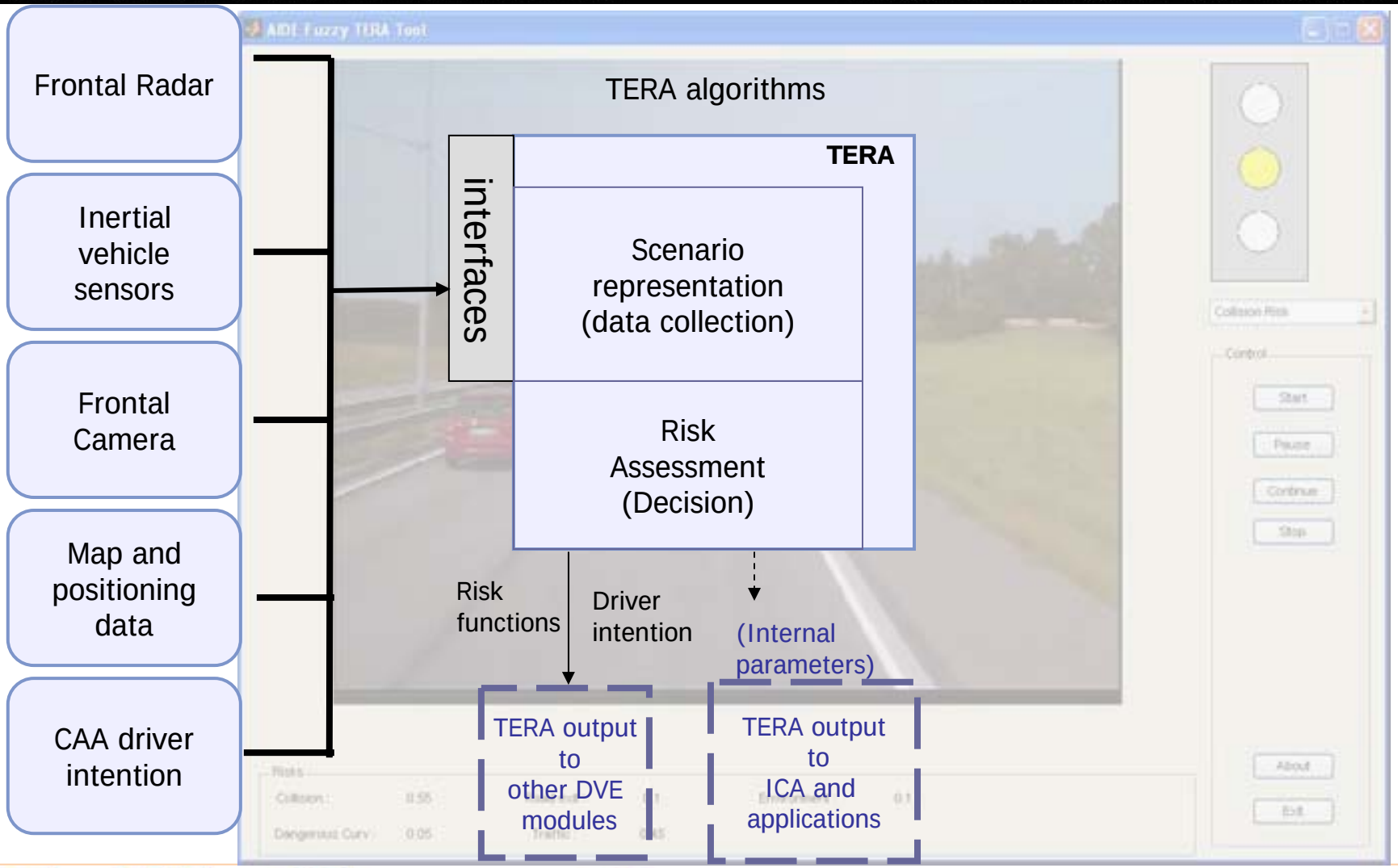
Traffic Environment Risk Assessment (TERA) module



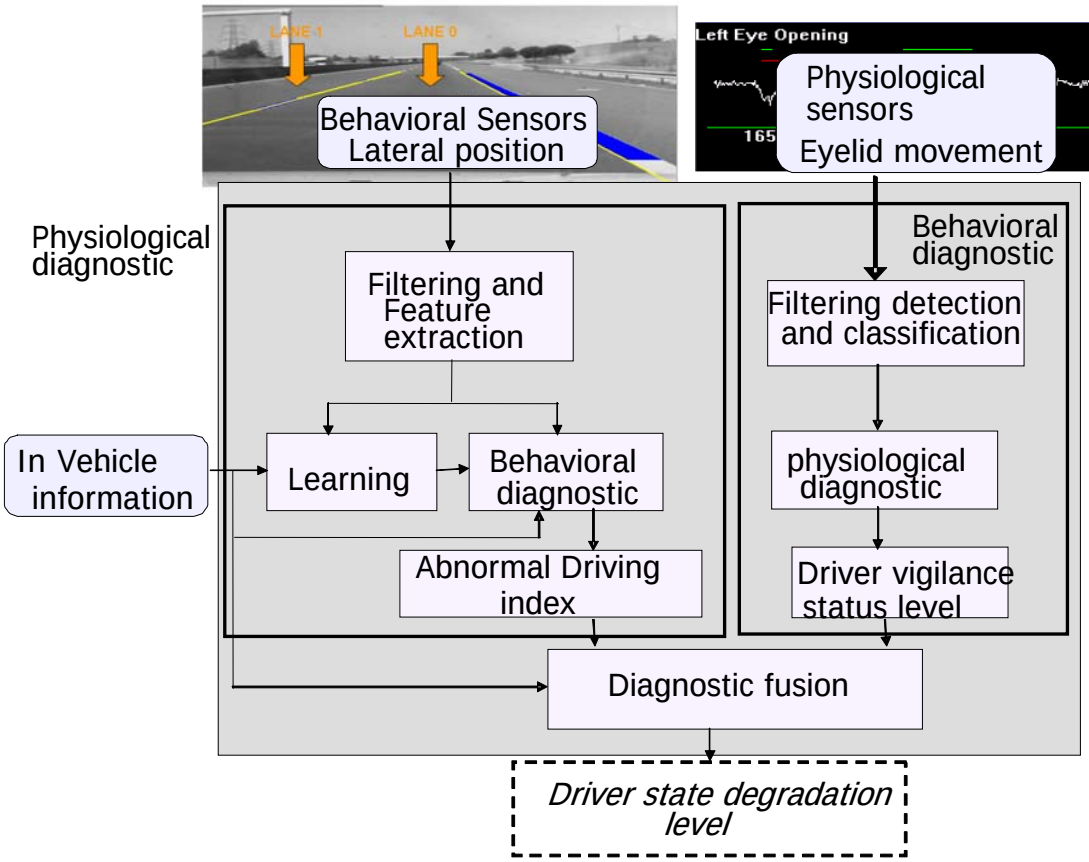
TERA role:

- *To calculate in real time a total level of risk related to traffic and environmental parameters.*
- *To calculate environmental and traffic parameters according to the requirements of the other DVE modules.*
- *To estimate the drivers' intention (e.g. for maneuver of a possible lane change).*

For example, existing sensors used by collision-warning systems and Global Positioning System (GPS) measurements of localization combined with a table of corresponding roadway characteristics could be used to help understand the environment outside the vehicle and adapt the HMI accordingly.


Frontal Radar
Inertial vehicle sensors
Frontal Camera
Map and positioning data
CAA driver intention
TERA algorithms
TERA
interfaces
Scenario representation (data collection)
Risk Assessment (Decision)
Risk functions
Driver intention
(Internal parameters)
TERA output to other DVE modules
TERA output to ICA and applications

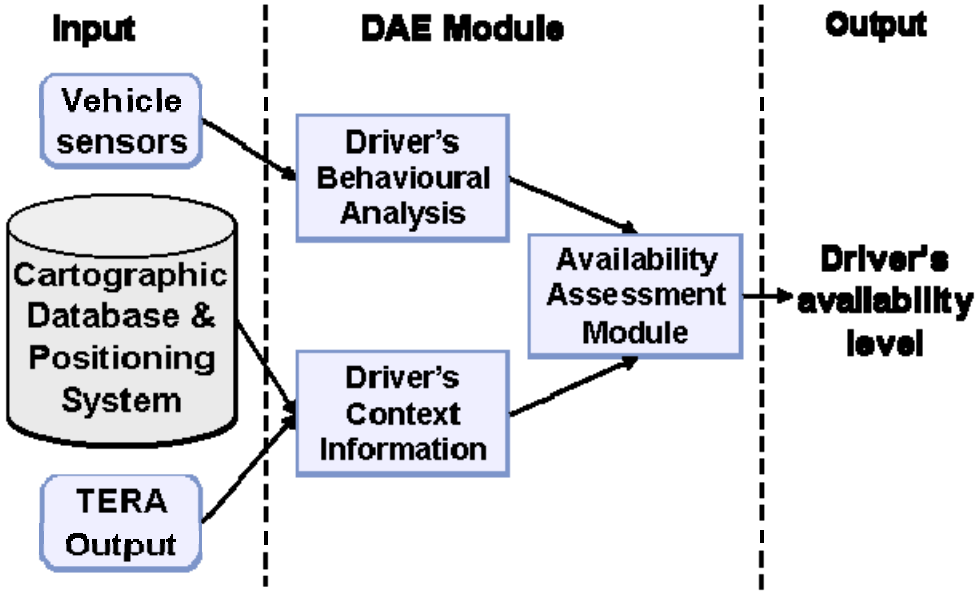
Driver State Degradation (DSD) module



Goal: Assess the evolution of the driver state degradation (physical ability).

- The DSD is based on the fusion of information provided by physiological and mechanical sensors.
- Several diagnostics are calculated: physiological diagnostic, and behavioural diagnostics; then fused with additional in-vehicle information.

Driver Availability Estimation (DAE) module

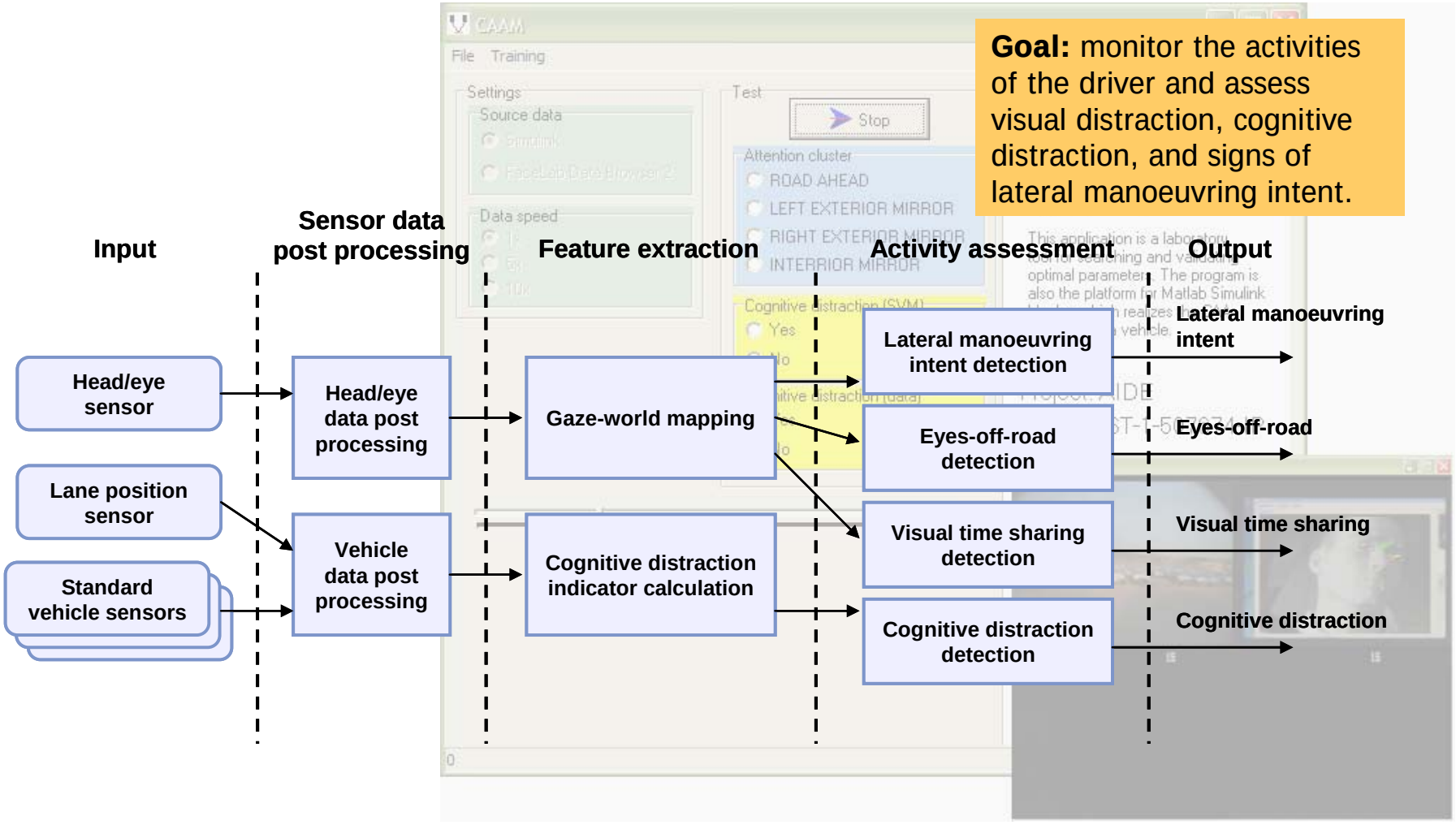


Goal: Assess the availability of the driver to receive and process an information at a given time

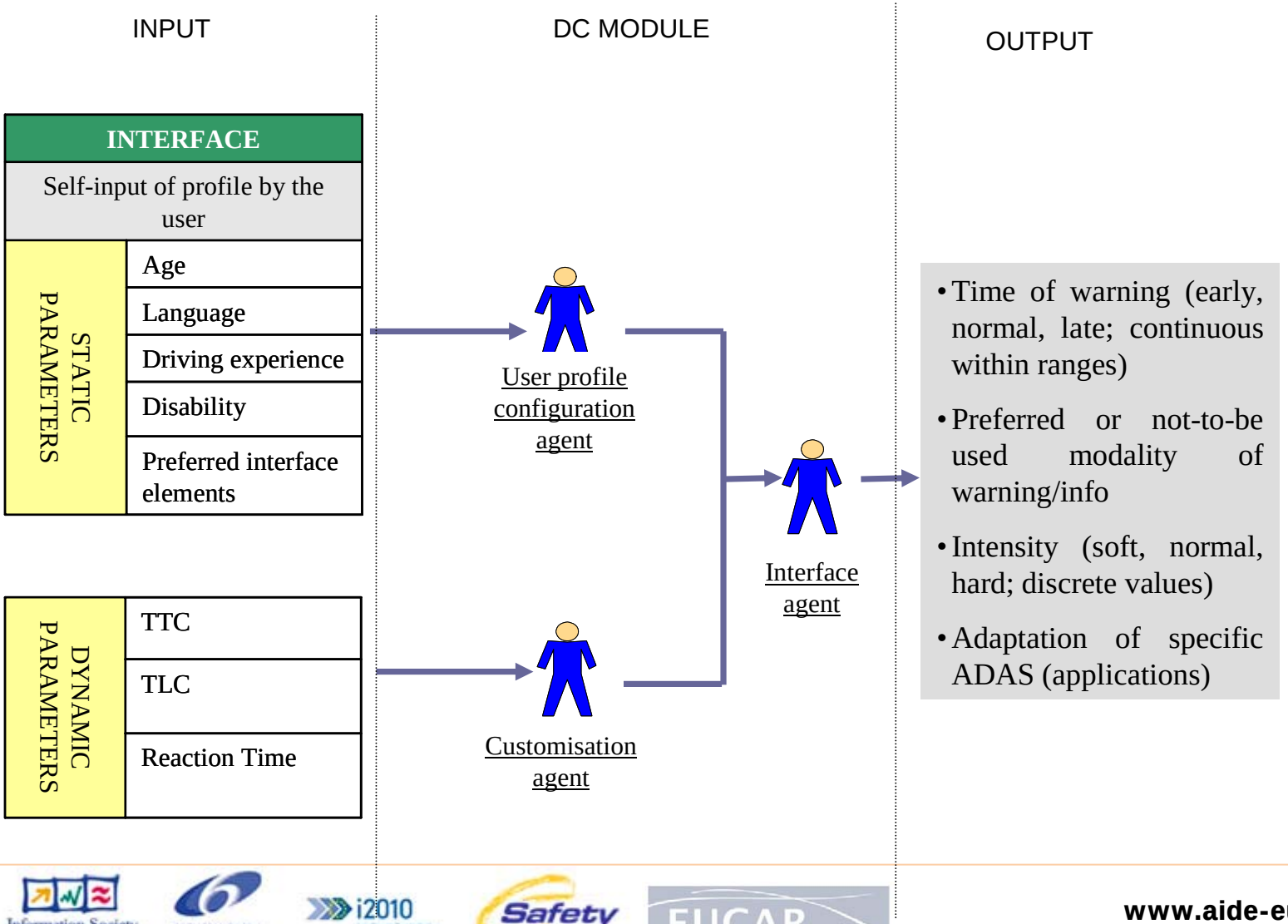
- Three levels of Availability / Unavailability:
- Available (Green): "I can receive and process information"
- Unavailable (Red): "I drive my car! Please don't disturb me"
- Intermediary level (Amber): "You can send information to me, if needed. But I'm not sure that I will be able to detect or to process it correctly at this time"

Cockpit Activity Assessment (CAA) module

Goal: monitor the activities of the driver and assess visual distraction, cognitive distraction, and signs of lateral manoeuvring intent.



Driver Characteristics (DC) module



Thank you for the attention!

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