

Les Véhicules Autonomes



Stéphane FERON :
Expert interface Homme Machine

Introduction

Système d'assistance :

Assistances à la conduite basées sur des informations internes

Direction assistée / Boite de vitesse automatique

Limiteur / régulateur de vitesse

ABS – ESP

Systèmes d'assistance avancés : ADAS (Advanced Driver Assistant System)

Assistances basées sur de la perception de l'environnement

Adaptative Cruise control/régulateur de vitesse intelligent

Lane Keeping Assist

Systèmes automatisés et autonome

Remplacement partiel ou total du conducteur dans sa tache de conduite

Taches opérationnelles

Taches tactiques

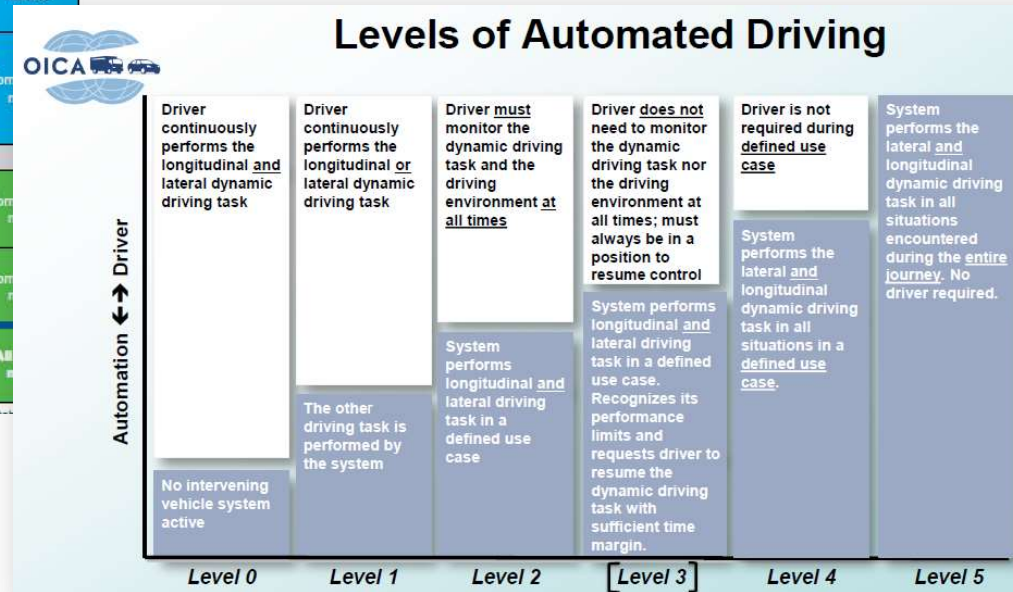
Introduction classification de l'automatisation

Définition SAE (J3016)

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a request to intervene	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a request to intervene	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

Définition OICA

Levels of Automated Driving



- Basées sur 3 critères principaux
 - Responsabilité du conducteur
 - Capacité du système à détecter ses limites
 - Capacité du système à gérer les situations imprévues

OICA definitions



No feet

Level 0 : Manual driving

Driver does everything



hands

Level 1 : Assisted driving

Vehicle performs longitudinal **OR** lateral driving task

Typically Adaptive Cruise Control



eyes



brain

Level 2 : Partial automation

Vehicle performs longitudinal **AND** lateral driving task

The system may not detect its limits

Driver monitors permanently the vehicle

→ Driver may have to take back the control immediately

No secondary tasks allowed



No feet



No hands



eyes



brain

OICA definitions

Level 3 : Conditional automation

During a specific use case

Vehicle performs longitudinal and lateral driving task

Vehicle recognizes its limits and handles emergency situations

Vehicle may ask for a take over with sufficient time margin

→ Driver has to be able to take over the control

Limited secondary tasks are allowed



Image Volvo



No feet



No hands



No eyes



brain

OICA definitions

Level 4 : High automation

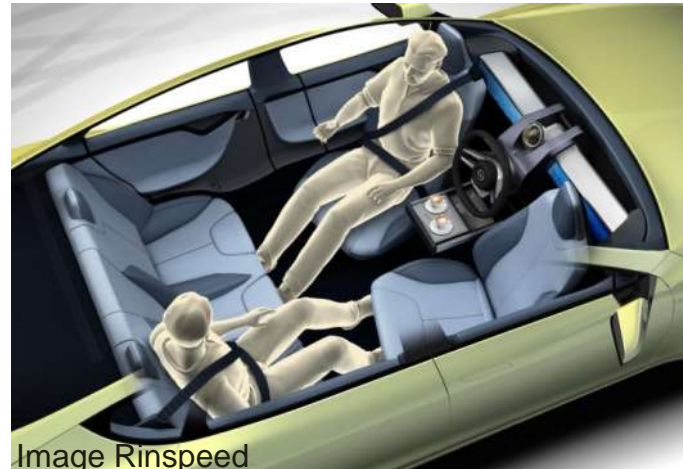
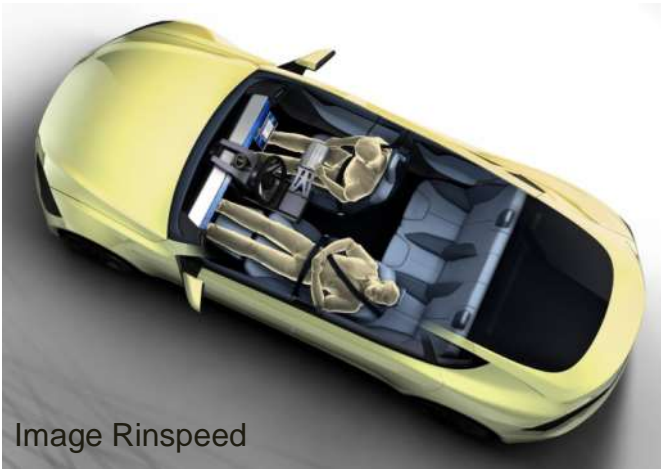
During a specific use case

Vehicle performs longitudinal and lateral driving task

Vehicle handles all situations (no take over needed)

Driver can have other activities

Free secondary tasks allowed



No feet



No hands



No eyes



No brain

OICA definitions

Level 5 : Full automation

During a complete trip

Vehicle handles all situations

No driver needed



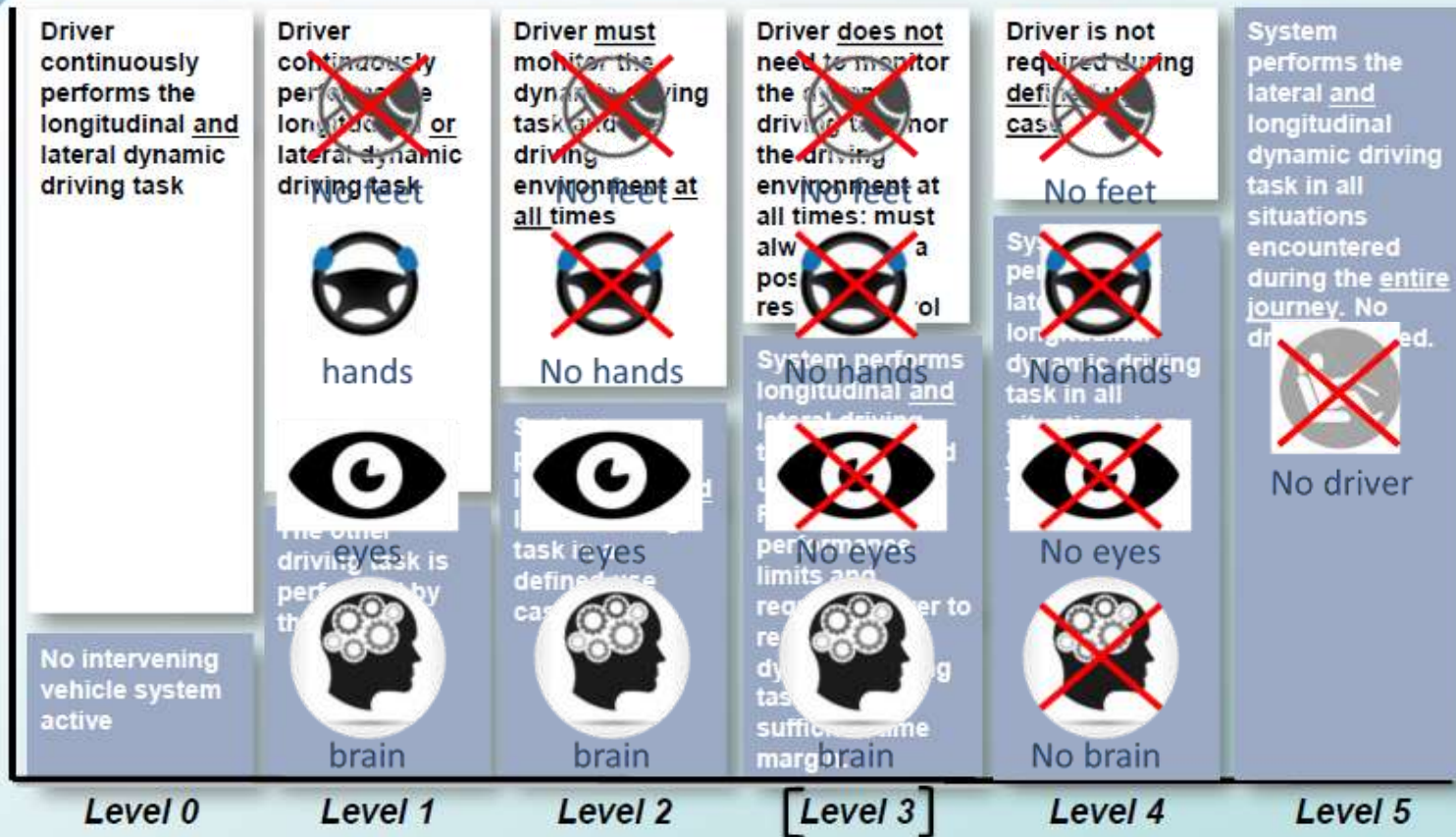
No driver

Introduction classification de l'automatisation

Levels of Automated Driving



Automation ← → Driver



General overview

Assisted Driving

Automated Driving

Autonomous Vehicle

Parking

Citypark

Full park assist

Parking remote

Parking Valet

Traffic Jam : Heavy traffic / Low speed

ACC Stop &Go

TJ Assist

TJ Chauffeur

TJ Pilot

Highway : Low traffic / High speed

ACC Stop &Go

Highway Assist

Highway Chauffeur

LKA

Highway Pilot

OICA levels

0

OICA

1

OICA

2

OICA

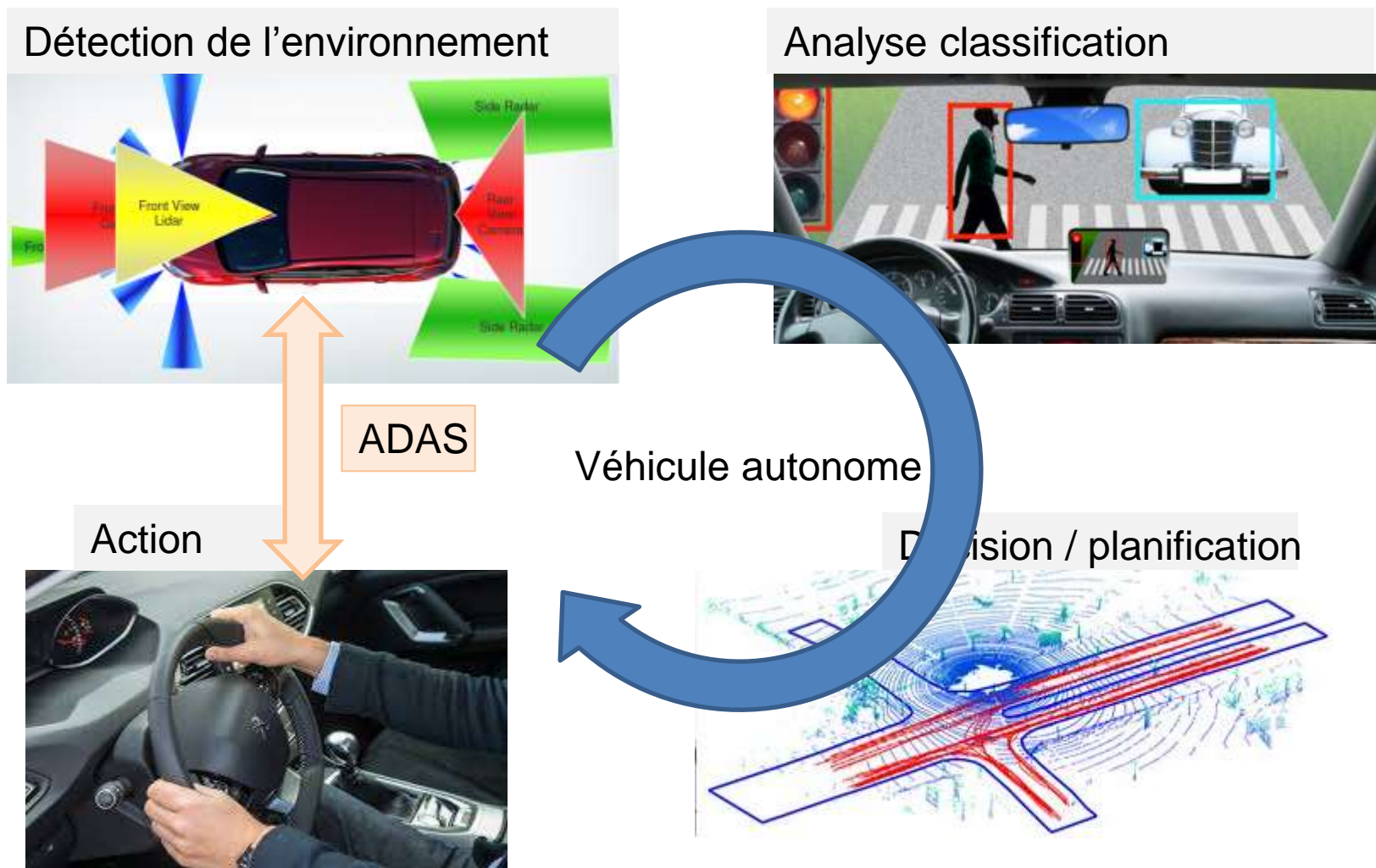
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OICA

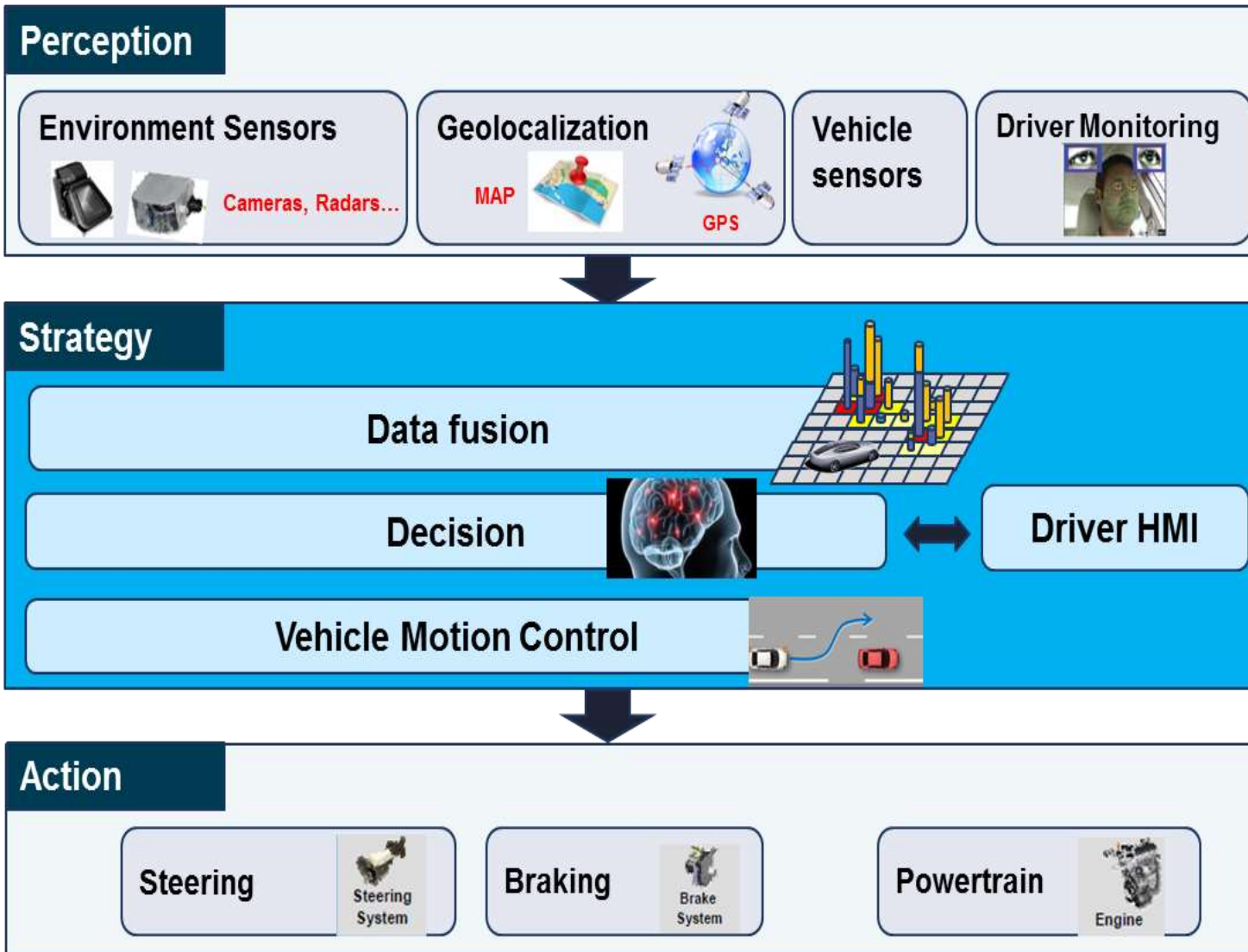
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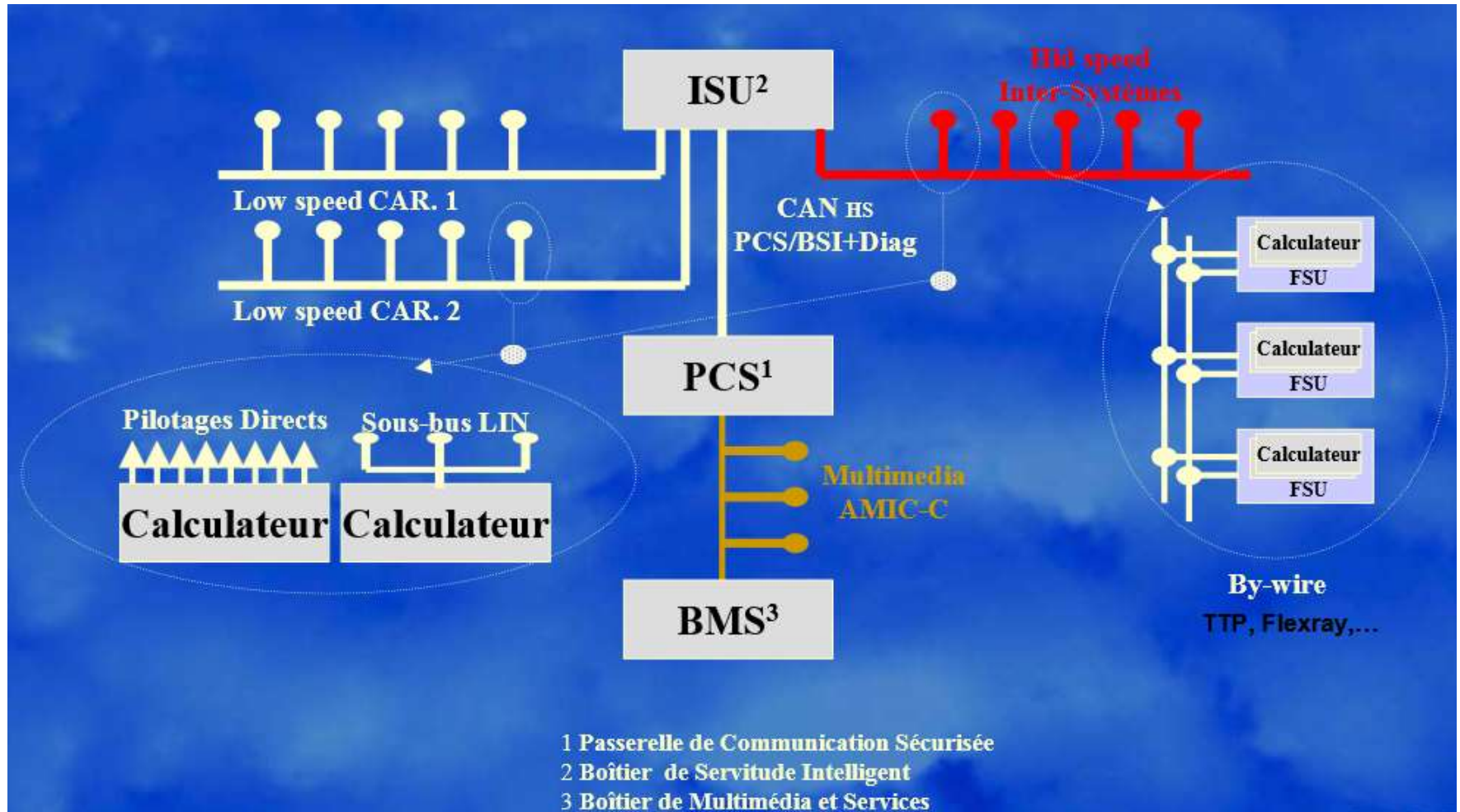
Décomposition d'un système de délégation de conduite



Architecture système



Architecture Electronique d'un véhicule



Capteurs

Automotive sensors



Radar camera



Lidar



Short range radars



Multifocal camera



Ultrasonic sensors



Surround view cameras



'Long range radar

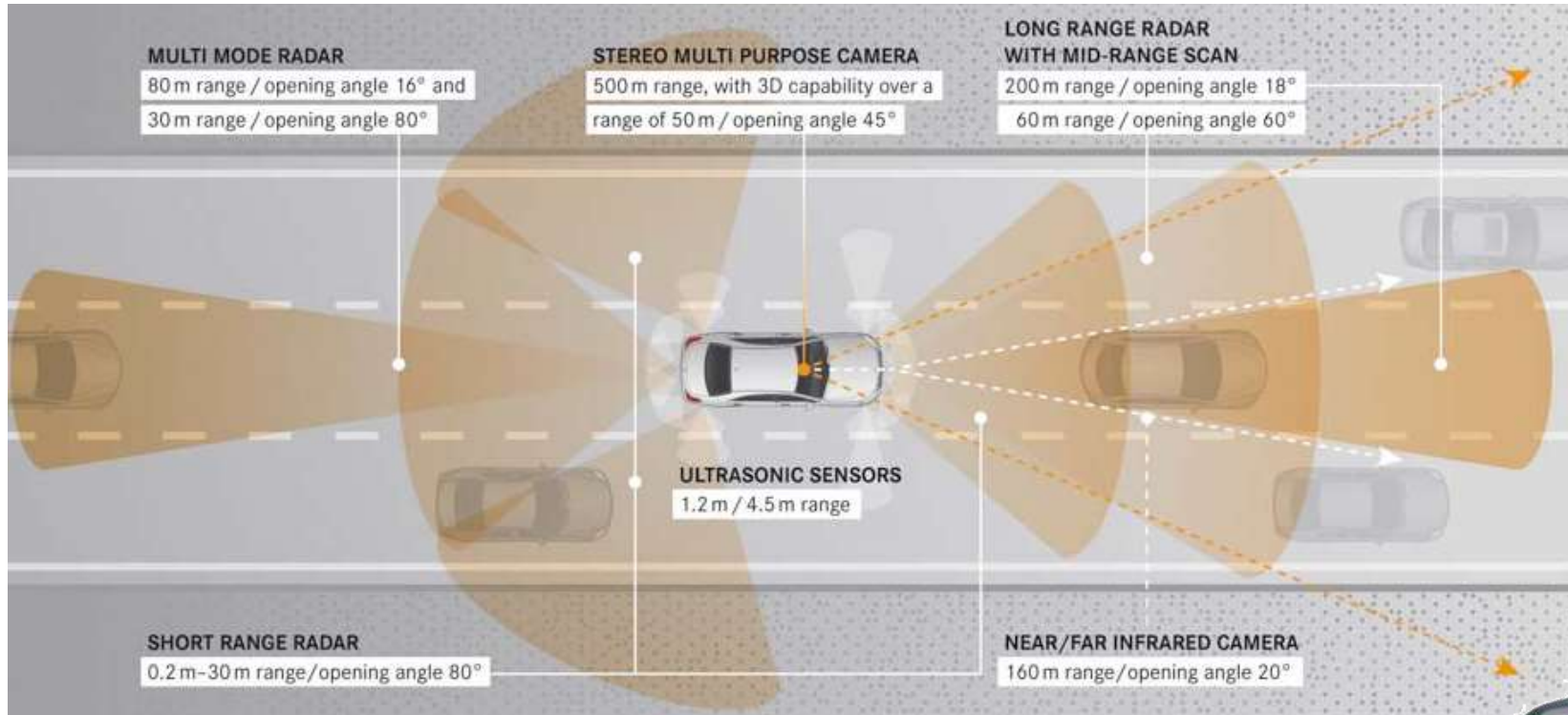
Technologies de détection

Tableau comparatif des performances

	Radar		Camera		Lidar		Ultrason
	Long range	Middle range	Mono	Stéréo	Single beam	Multi-beam	
Range	5	4	4	3	2	4	1
Perf. Longi.	5	5	3	4	4	5	3
Perf. Latérale	3	3	5	5	2	5	2
Weather	4	4	2	2	3	3	3
Visibility (night)	5	5	2	2	5	5	5
Object data	4	4	4	5	2	4	1
Stationary object	3	2	5	5	5	5	5
Regulation	4	3	5	5	3	3	5
Integration	3	3	4	2	3	1	4
Calibration	4	3	4	2	4	2	4
Maturity	5	5	5	4	5	3	5
Cost	4	3	4	3	5	2	5

Capteurs - set complet pour l'assistance

Mercedes Classe S - 2014



Radars
Cameras
Capteurs Ultrason



Détection du véhicule autonome

Pour assurer la sécurité il faut sécuriser la détection :

En frontal : triple redondance avec 3 technologies différentes.

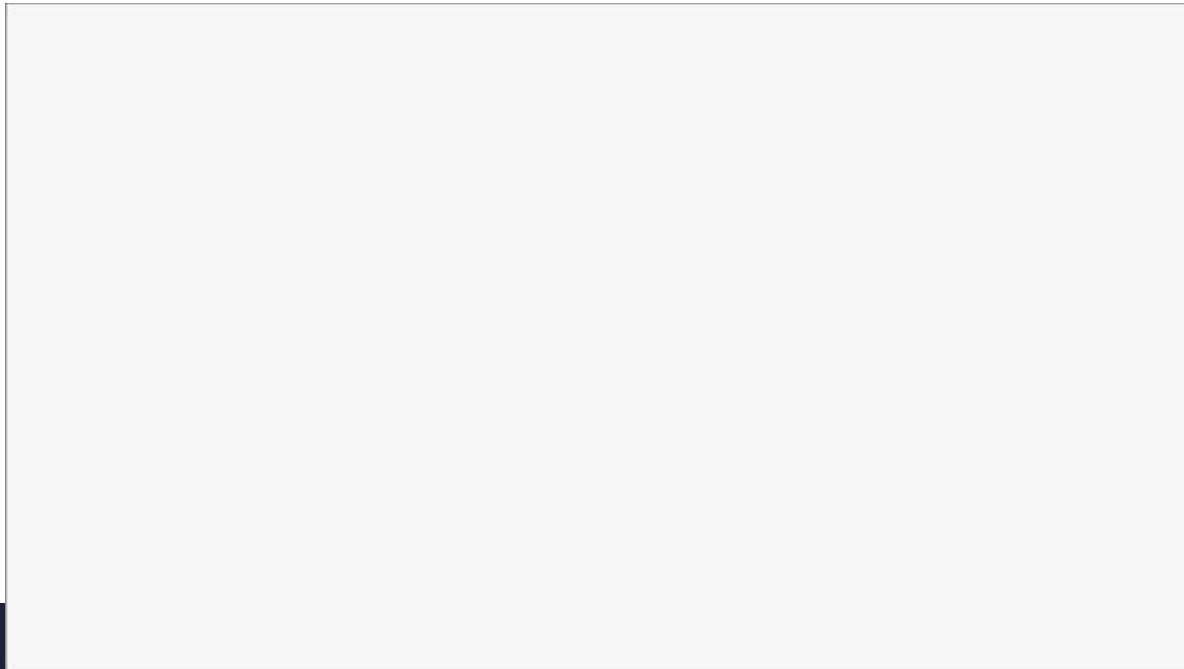
Radar / Camera / Lidar

Cela permet de trancher dans les cas où caméra et radar sont pas d'accord

Ombre sur la route vue par la caméra

Canette de boisson sur la route vue par le radar

Mur de fumée non vu par le radar



Cas Exotiques Rencontrés



Actionneurs

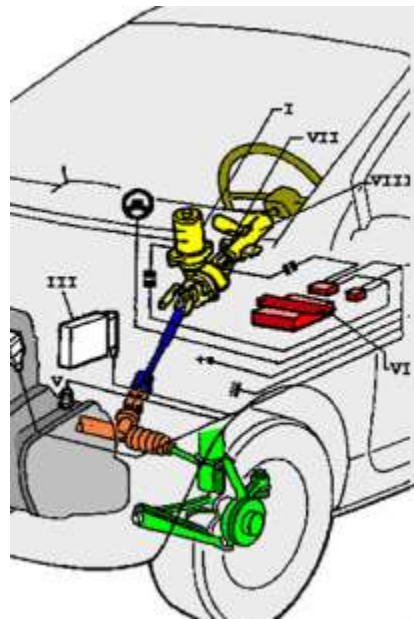
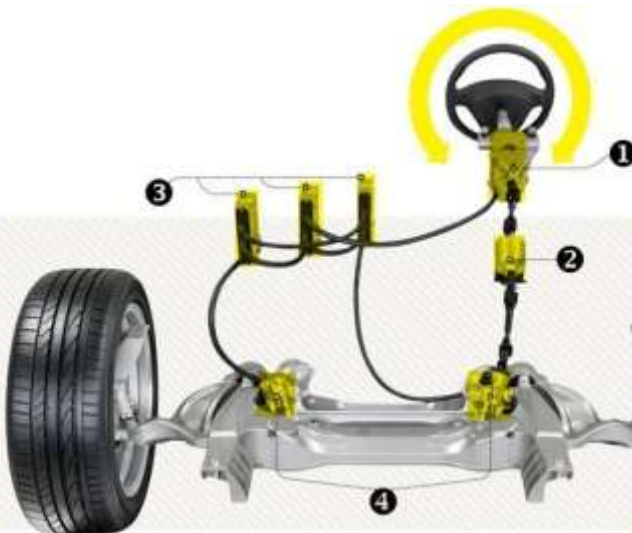
Actionneurs

Dans l'ordre d'apparition dans l'automobile

Contrôle de l'accélération par le papillon motorisée

Contrôle du frein par l'ESP

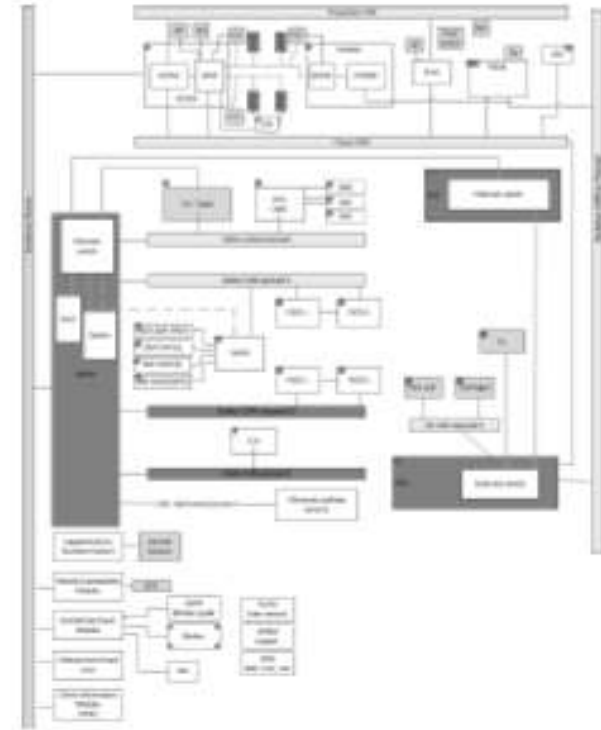
Contrôle de la direction par la direction assistée électrique



Impacts sur le véhicule

AD level 3 Vehicles require:

- Redundant sensing
- Redundant high-end control units
- Redundant brake system
- Redundant steering
- Redundant signaling paths
- Clustered power distribution
- Safety critical HMI



Etage de décision

Perception

Environment Sensors



Cameras, Radars...

Geolocation

MAP



GPS

Vehicle sensors

Driver Monitoring



Strategy

Data fusion



Decision



Driver HMI

Vehicle Motion Control



Action

Steering



Steering System

Braking



Brake System

Powertrain



Engine

Situation PSA

Présentation presse – Juin 2015



Depuis 2015 : expérimentations VA



4 immatriculations "W" spécifiques délivrées à PSA par les autorités
Plus de 10000 km de voies rapides en France et 4000 km en Espagne

France



Région parisienne



Espagne



Trajets complets en mode autonome : Paris-Bordeaux (550 km) - Vigo-Madrid (600 km) - Europe tour (>3000 km)

3 véhicules en cours de test :

60 000 km parcourus de Juillet 2015 à septembre 2016

Fonctions testées : Traffic Jam Chauffeur, Highway Chauffeur avec dépassement



Moyens d'étude Facteurs HUMAIN

Lane change maneuver

Simulator study

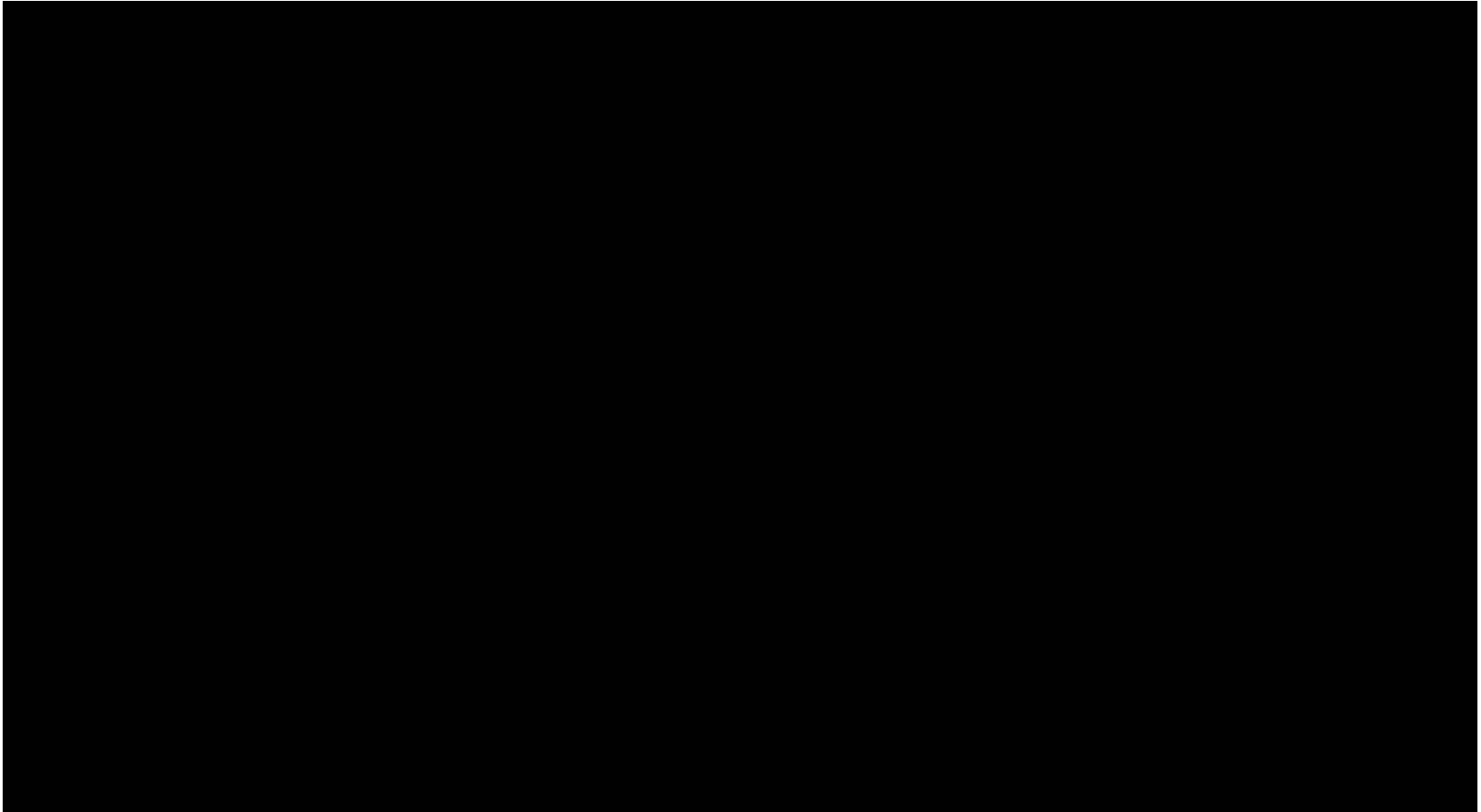


PSA - Prototype dedicated to HMI study

Mobil lab

First user test - July 2015

Braga test track (Portugal)



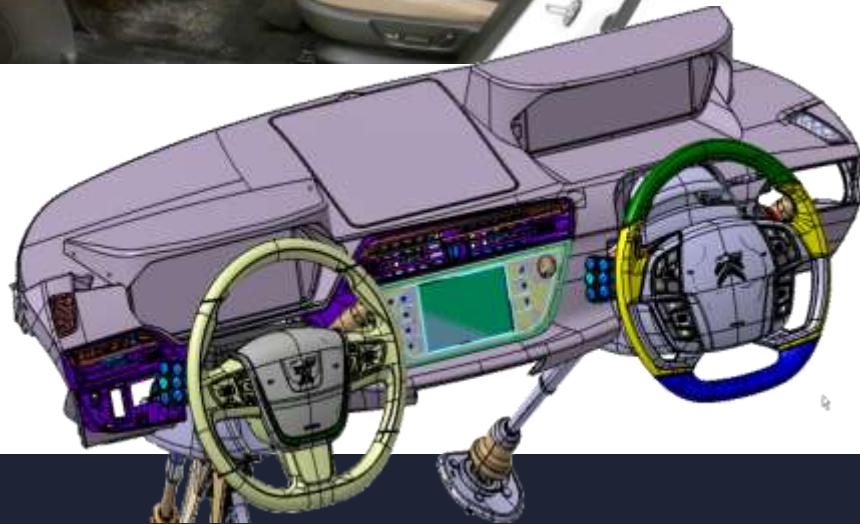
User study - Wizard of Oz vehicle

Right hand driving car with a fake left hand cockpit

The left steering wheel moves like the right one

User experience tests in real conditions

Open road / Standard user



Merci de votre attention

Les questions sont les bienvenues