

# AUTONOMOUS VEHICLE



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**USER SAFETY**

**FREE TIME RECOVERY**

**EASIER LIFE**



**A LARGE SET OF ADAS FEATURES**

FROM PARTIAL AUTOMATION...

... TO AUTONOMOUS DRIVING

# AVA: AUTONOMOUS VEHICLE FOR ALL

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**A PROGRAM OF AUTOMATED FEATURES**

... for ...

**COMFORTABLE & SAFE** driving experience

**EASY & INTUITIVE** autonomous cars

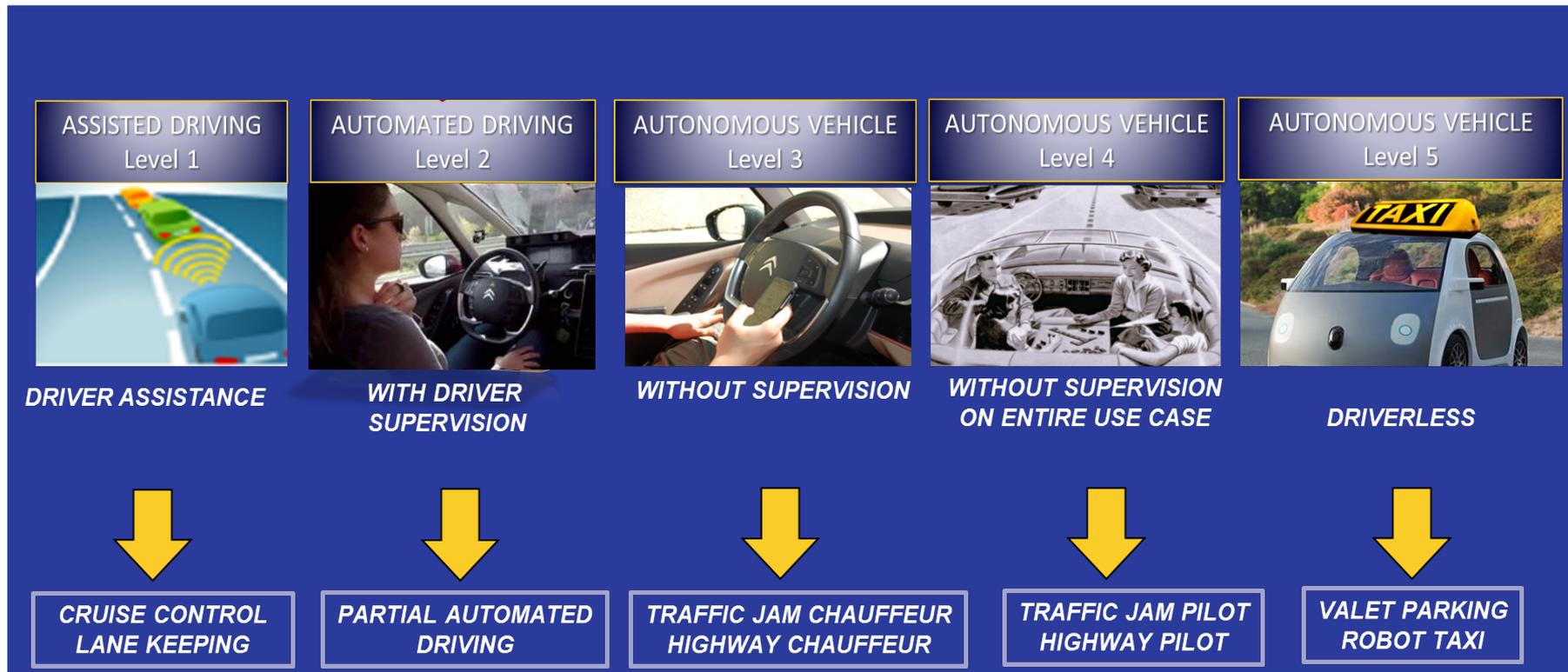
## CONTEXT : ADAS

Advanced Driver Assistance Systems (ADAS) : Set of hardware and software that improve/extend the vision of the driver, help him to decide, and take control on the car.

ADAS can be informative, or it can take control on the car (partially or totally).



# LEVEL OF AUTOMATION



# JSAE2016 guideline: automation level 1 and 2

Level	Name	Narrative definition	DDT		DDT fallback	ODD
			Sustained lateral and longitudinal vehicle motion control	OEDR		
Driver performs part or all of the DDT						
0	No Driving Automation	The performance by the <i>driver</i> of the entire <i>DDT</i> , even when enhanced by <i>active safety systems</i> .	<i>Driver</i>	<i>Driver</i>	<i>Driver</i>	n/a
1	Driver Assistance	The <i>sustained</i> and <i>ODD</i> -specific execution by a <i>driving automation system</i> of either the <i>lateral</i> or the <i>longitudinal vehicle motion control</i> subtask of the <i>DDT</i> (but not both simultaneously) with the expectation that the <i>driver</i> performs the remainder of the <i>DDT</i> .	<i>Driver and System</i>	<i>Driver</i>	<i>Driver</i>	Limited
2	Partial Driving Automation	The <i>sustained</i> and <i>ODD</i> -specific execution by a <i>driving automation system</i> of both the <i>lateral</i> and <i>longitudinal vehicle motion control</i> subtasks of the <i>DDT</i> with the expectation that the <i>driver</i> completes the <i>OEDR</i> subtask and <i>supervises</i> the <i>driving automation system</i> .	<b>System</b>	<i>Driver</i>	<i>Driver</i>	Limited

OEDR: Object and event detection, classification, and response  
 DDT: Dynamic Driving Task  
 ODD: Operational Driving Domain

# JSAE2016 guideline: automation level 3 to 5

.level	Name	Narrative definition	DDT		DDT fallback	ODD
			Sustained lateral and longitudinal vehicle motion control	OEDR		
ADS ("System") performs the entire DDT (while engaged)						
3	Conditional Driving Automation	The <i>sustained</i> and <i>ODD</i> -specific performance by an ADS of the entire DDT with the expectation that the <i>DDT fallback-ready user</i> is <i>receptive to ADS-issued requests to intervene</i> , as well as to <i>DDT performance-relevant system failures</i> in other vehicle systems, and will respond appropriately.	System	System	<i>Fallback-ready user (becomes the driver during fallback)</i>	Limited
4	High Driving Automation	The <i>sustained</i> and <i>ODD</i> -specific performance by an ADS of the entire DDT and <i>DDT fallback</i> without any expectation that a <i>user</i> will respond to a <i>request to intervene</i> .	System	System	<b>L3+</b> System	Limited
5	Full Driving Automation	The <i>sustained</i> and unconditional (i.e., not <i>ODD</i> -specific) performance by an ADS of the entire DDT and <i>DDT fallback</i> without any expectation that a <i>user</i> will respond to a <i>request to intervene</i> .	System	System	System	Unlimited

## SUPERVISED BY DRIVER

## UNSUPERVISED

### Level 1



**ADAPTIVE CRUISE CONTROL (ACC)** -> Longitudinal

**AUTO. EMERGENCY BRAKING (AEB)** -> Longitudinal

**LANE KEEPING ASSIST (LKA)** -> Lateral

### Level 2



**HIGHWAY INTEGRATED ASSIST (HIA)** -> Longitudinal + Lateral

**CITY PARK (CPK)** -> Longitudinal + Lateral

**HIGHWAY INTEGRATED ASSIST W. LANE CHANGE (HIA+)** -> Longitudinal + Lateral

### Level 3 & 4

**TRAFFIC JAM CHAUFFEUR (TJC)** -> Longitudinal + Lateral

**HIGHWAY CHAUFFEUR (HC)** -> Longitudinal + Lateral

**VALET PARKING (VPK)** -> Longitudinal + Lateral + Remote

2015

2018

2020

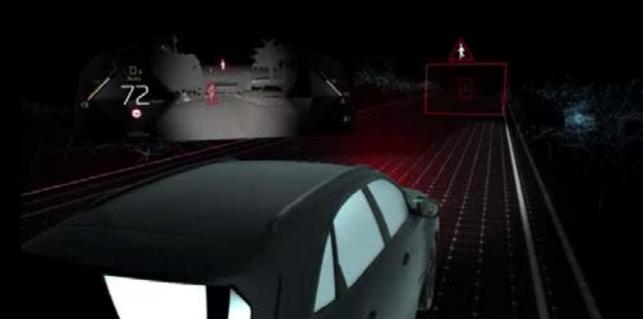
2022

2025

# ADAS LEVEL 2 : LAUNCHED ON DS7 CROSSBACK



DS CONNECTED PILOT



DS NIGHT VISION



DS DRIVER ATTENTION MONITORING



DS PARK PILOT

# TRAFFIC JAM CHAUFFEUR (level 3)

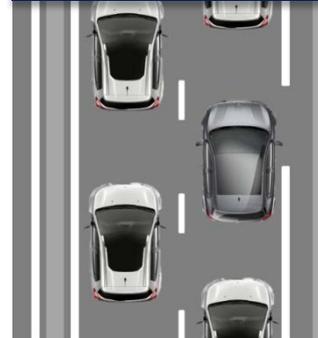
Autres activités autorisées



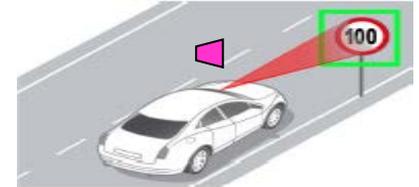
Contrôle longitudinal & Latéral automatique



Conditions d'embouteillage



Limitation de vitesse et adaptation de la vitesse en courbe



**Contrôles latéral et longitudinal dans la voie** (sans changement de voie)

**Volant lâché et possibilité d'autres activités pour le conducteur**

**Désengagement avec transition** (jusqu'à 10s / temps de reprise en main)

Plage de vitesse = **[0/60km/h]** + respect automatique limite réglementaire

Activable uniquement sur **voies chaussées séparées éligibles et en embouteillage**

# TJC vs HC

## Traffic Jam Chauffeur



Eyes Off

Traffic Jam Conditions

Speed Range = [0-60 kph]

No lane change

Minimum Risk Maneuver L3+

Driver Monitoring

Approved Dual Carriage Way

No route planning

## Highway Chauffeur



Eyes Off

No condition on Traffic

Speed Range = [0-130 kph]

With autonomous lane change

Minimum Risk Maneuver L3+

Driver Monitoring

Approved Dual Carriage Way + **TbC**

Route planning



# ADS TAKEOVER REQUEST

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	<b>TJC Anticipated request</b>	<b>HC Anticipated request</b>
End of approved road	Yes	Yes
End of Traffic Condition	Rarely	Not applicable
Unwanted Driver Behavior	No	No
Unappropriated Weather conditions	Sometimes	Often with situation management
Temporary unappropriated Infrastructure quality	Rarely	Often with situation management
Incapacity to manage Infrastructure complexity (lane merge, workingzone)	Sometimes	Often with situation management
Internal failure	Rarely	Often with situation management

# EXAMPLES





## MAIN CHALLENGES OF DRIVING AUTOMATION

**Performance & Safety**

**Customer Trust**

**Product Liability**

***Regulation***

# MAIN TECHNICAL ISSUE: SAFETY

## **Safety managed by the system** (driver out of the loop)

- **Surrounding detection & analysis => 100% reliable**
  - in all weather conditions
  - independently of infrastructure quality
- **Decision making and actions => 100% adapted**
  - capacity to decide in case of unexpected situation
  - behave like a human driver (Artificial intelligence)



→ **Strong Experimentation plan is needed**

→ **Data base collection, and massive HP simulation needed**

# Classification ASIL

		Exposition x Contrôlabilité					
		1	0,1	0,01	10 <sup>-3</sup>	10 <sup>-4</sup>	10 <sup>-5</sup>
Sévérité	S0	QM	QM	QM	QM	QM	QM
	S1	ASIL B	ASIL A	QM	QM	QM	QM
	S2	ASIL C	ASIL B	ASIL A	QM	QM	QM
	S3	ASIL D	ASIL C	ASIL B	ASIL A	QM	QM

E1 (très faible) : 0,001

E2 (faible) : 0,01

E3 (moyenne) : 0,1

E4 (forte) : 1

C1 (facilement contrôlable) : >99%

C2 (normalement contrôlable) : >85%

C3 (difficile ou impossible à contrôler) : < 85%

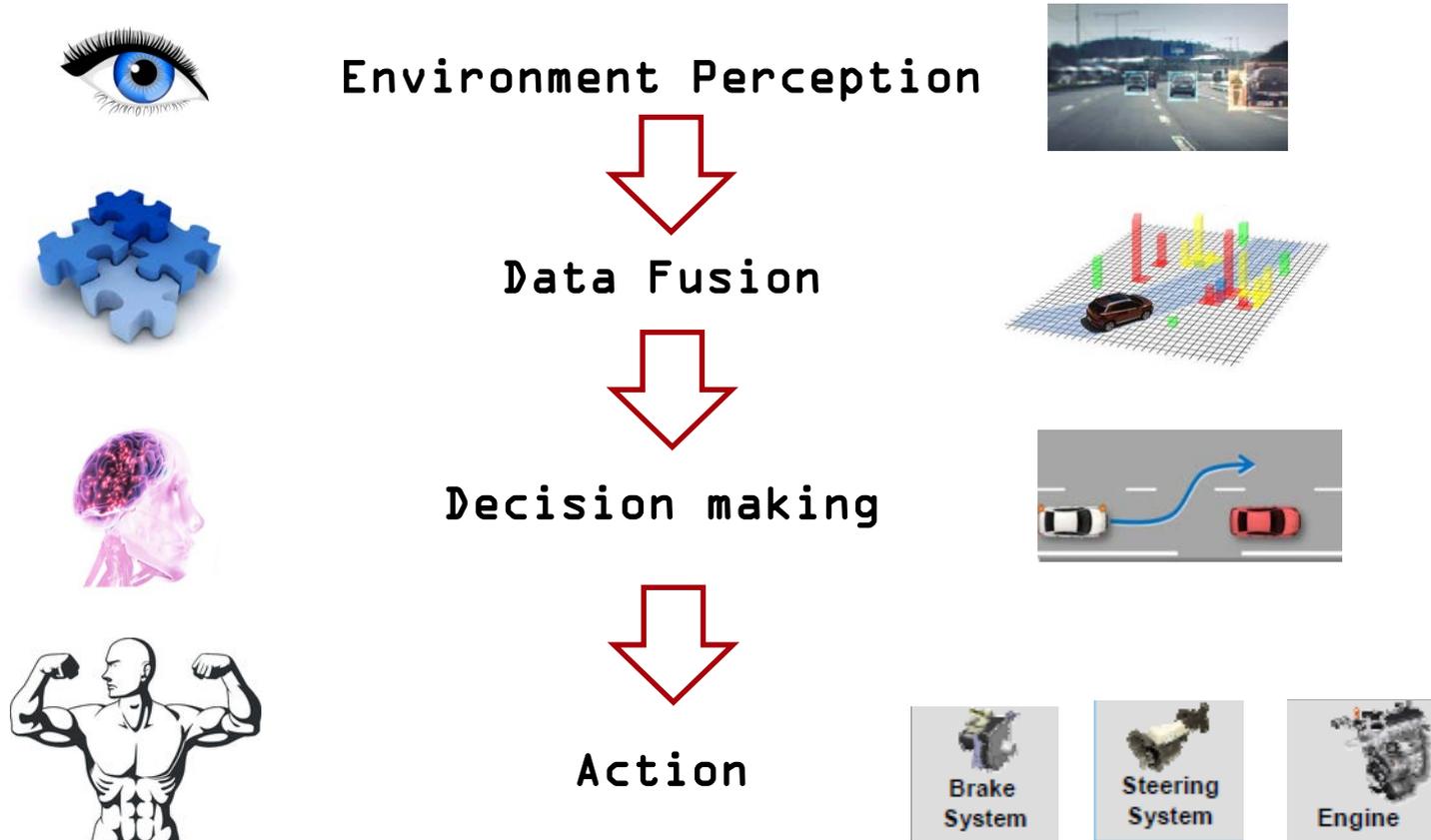
S0 : pas de dommage corporel (AIS 0)

S1 : blessures légères ou modérées (AIS 1 et 2)

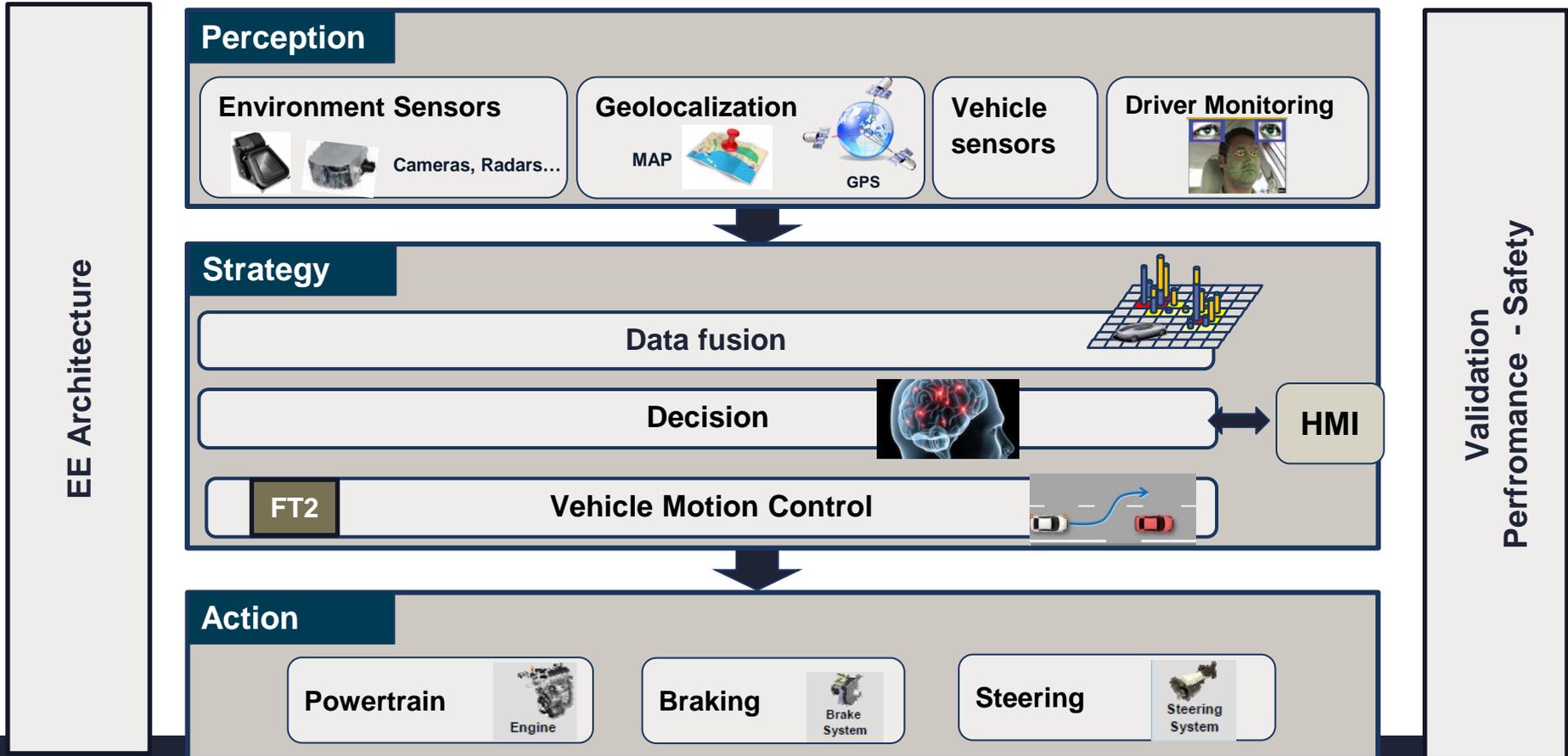
S2 : blessures sérieuses (AIS 3 et 4)

S3 : blessures graves avec pronostic vital engagé, blessures mortelles (AIS 5 et 6)

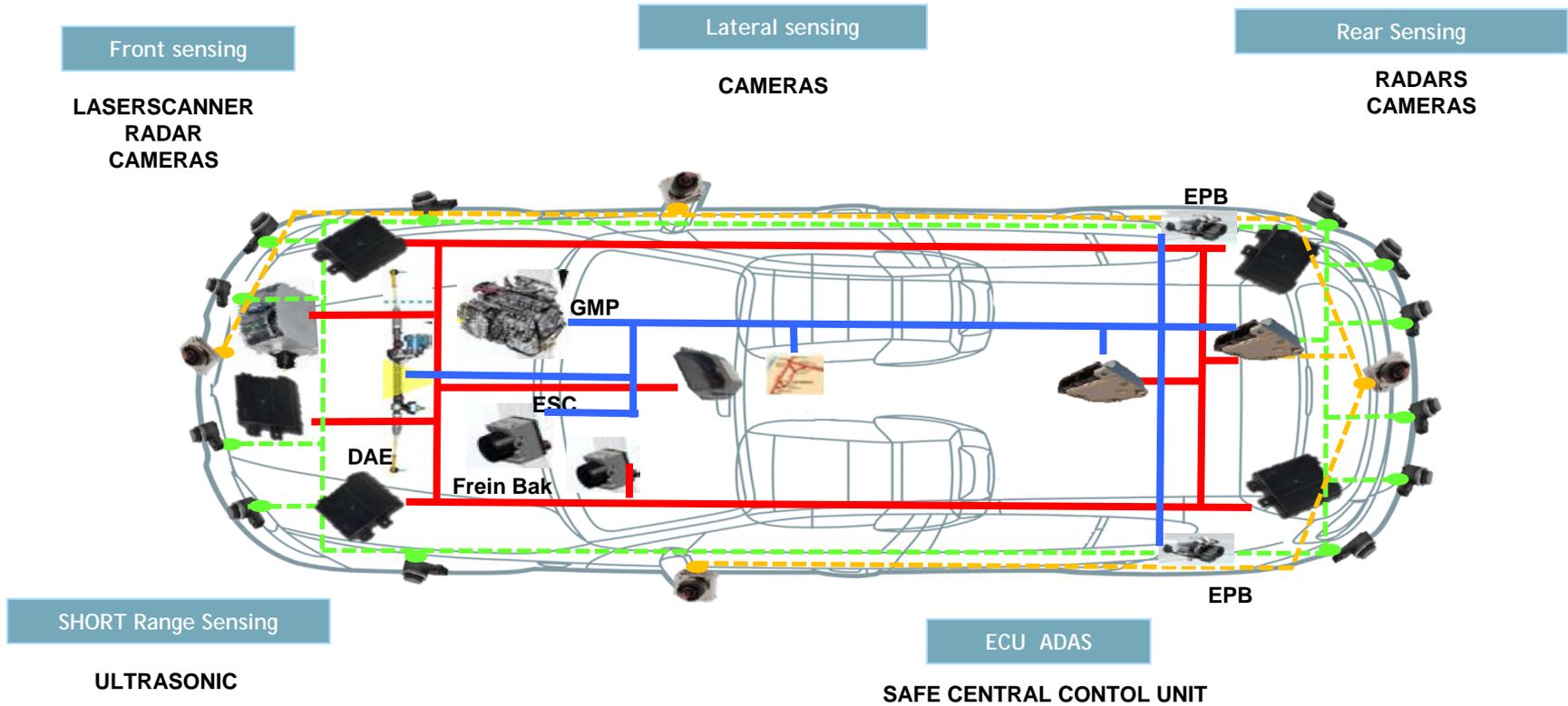
# FROM PERCEPTION TO ACTION



# GLOBAL ARCHITECTURE



# VEHICLE ARCHITECTURE



## AUTONOMOUS CARS TESTS ON OPEN ROADS

- **150 000KM IN AUTONOMOUS MODE**
  - WITH LEVELS 2, 3 & 4 ON EUROPEAN ROADS SINCE JULY 2015
  - 1ST CARMAKER TO OBTAIN THE FRENCH AUTHORIZATIONS
- **20 PROTOTYPES**
  - TESTED IN-HOUSE OR WITH OUR PARTNERS
  - 12 LICENSES PLATES FOR INTERNAL PSA AUTONOMOUS CARS
- **EXPERIMENTATIONS WITH “NON-EXPERTS” DRIVERS**
  - 1ST CARMAKER TO OBTAIN THE AUTHORIZATIONS
  - TESTS STARTED ON MARCH 2017 ... MORE TO COME SOON
- **EXPERIMENTATIONS AERAS**
  - FRANCE > 10000KM EXPRESSWAYS
  - SPAIN > 1500KM HIGHWAYS
  - UK ALL HIGHWAYS
  - NETHERLANDS, ALL ROADS
  - CHINA : 5000 KM DRIVEN IN ADAS MODE, TEST PLANNED 2018



# Vehicles tested



## EXPERIMENTATION RESULTS (EXTRACT)

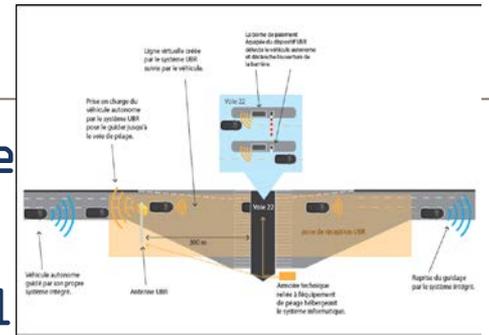
		Good Lane marking	Bad Lane marking	Working Zone	Infrastructure evolution	Unusual obstacles	Particular user behav.	Tunnels
<b>Road type 1 (Ax) - Fluent traffic</b>								
<b>Weather</b>	Normal or Bad	OK	OK	>90%	OK	>50%	OK	>90%
	Bad & Night	>90%	>50%	>90%	>90%			
	Very Bad	>50%	<50%	>50%	>90%			
<b>Other expressways - Fluent traffic</b>								
<b>Weather</b>	Normal or Bad	OK	OK	>50%	>90%	>50%	>90%	>90%
	Bad + Night	>90%	>50%	>50%	>90%			
	Very Bad	>50%	<50%	>50%	>90%			
<b>Dense traffic - Low speed</b>								
<b>Weather</b>	Normal or Bad	OK	OK	>90%	OK	>90%	>50%	OK
	Bad + Night	>90%	>90%	>90%	>90%			
	Very Bad	>50%	>90%	>50%	>90%			

# DIFFICULTIES TO MANAGE



## RESULTS: TOLL MANAGEMENT

- First results obtained for Toll management combining autonomous driving and V2I
- Principle = trajectory sent by the toll (300m before) using G5 (Wi-Fi) standard
- Obstacles managed in real time by surrounding sensors
- Toll is passed by precise control of the trajectory and self localization
- Cooperation w Vinci Autoroute in coherence standards defined in cooperative projects (ROADS...)



# ECOSYSTEM OF WORLDWIDE PARTNERS

« Nouvelle France Industrielle » project,  
VEDECOS & System-X

Research Chaire with Berkeley, EPFL, JiaoTong  
and Mines Paristech

Joint LAB PSA-SAFRAN-VALEO

Partnership with CTAG

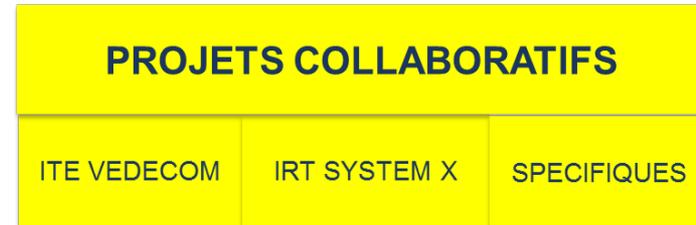
OpenLabs, worldwide laboratory network

Suppliers Cooperation

Startup partnerships



1. Plus de 120 acteurs impliqués (opérateurs de transport public, constructeurs, équipementiers, laboratoires de recherche, PME, société d'expertise, gestionnaire d'infrastructures dans 15 groupes de travail
2. Interface opérationnelle avec le groupe inter-administration, la « task force véhicules automatisés », et le comité de pilotage du plan NFI.



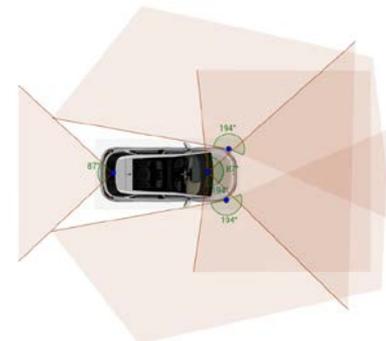


## 6 véhicules instrumentés MOOVE

- ✓ De capteurs intelligents de 4 technologies (Radar, Lidar, Camera, Ultrasons)
- ✓ De cameras de réalité terrain

## et équipés d'un outil de collecte de données

- ✓ Relatives aux objets mobiles et statiques autour de l'ego-véhicule
- ✓ Relatives aux infrastructures
- ✓ Relatives aux conditions d'environnements (yc météo)



Qui sont stockées sur un SERVEUR HW chez VEDECOM, accessible aux partenaires

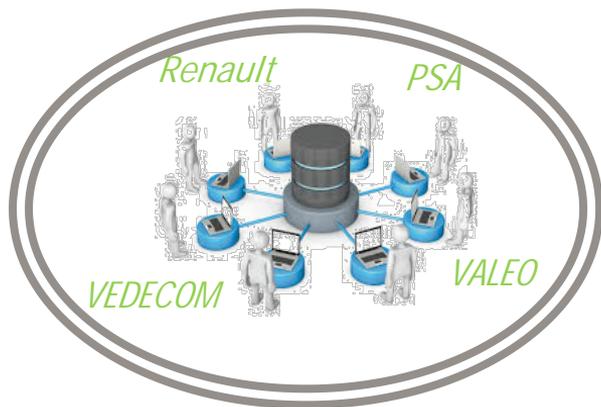
Gamme de roulage en fonction des uses-cases : parcours, indicateurs/TdB en relation avec les uses-case,.. Et optimisation et modelisation des parcours et scènes à rechercher





Collecte de données, enregistrement, synchronisation, décodage, gestion des erreurs

Stockage, Visualisation, annotations  
algs d'extraction des données  
accès déporté...



**rtMaps**

**Applicatif**

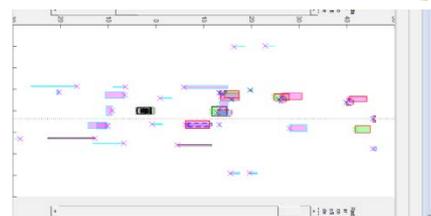
- Gestion du stockage
- Gestion des modes
- Gestion de la configuration
- Communication avec débarqué
- Pilotage de rtMaps
- Autodiagnostic

**Linux**



**IHM**

- Témoin d'état et diagnostic
- Télécommande d'enregistrement
- Annotation dynamique
- Changement de mode de fonctionnement



scene (initial)	action
Ego vehicle and target on the same lane	The ego vehicle changes lane.

## CONCLUSION

- **Autonomous vehicle: why?**  
Customer expectations, road safety
- **Technologies**  
Major challenges on performance and safety

