AUTONOMOUS DRIVING

A MAJOR DISRUPTION FOR AUTOMOTIVE INDUSTRY

Rémi BASTIEN

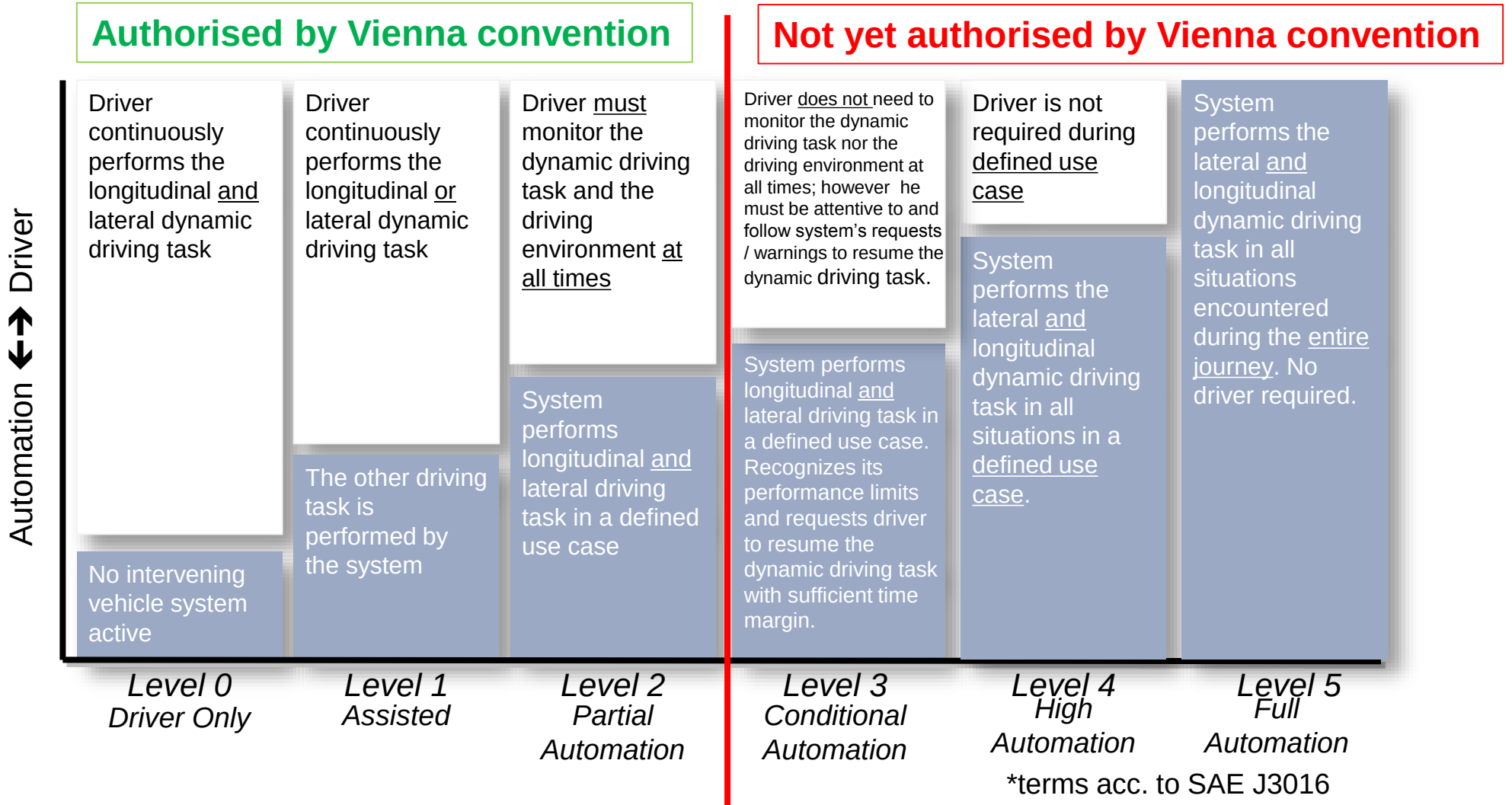
AUTONOMOUS DRIVING MORE AND MORE ON STAGE

FOUR HIGH STAKES FOR MOBILITY

- 90% accidents due to human errors
- 78 minutes each day in car, in Ile de France
- 45% of French population with access to public transport
- 30% to 60% delivery time for driving in urban city

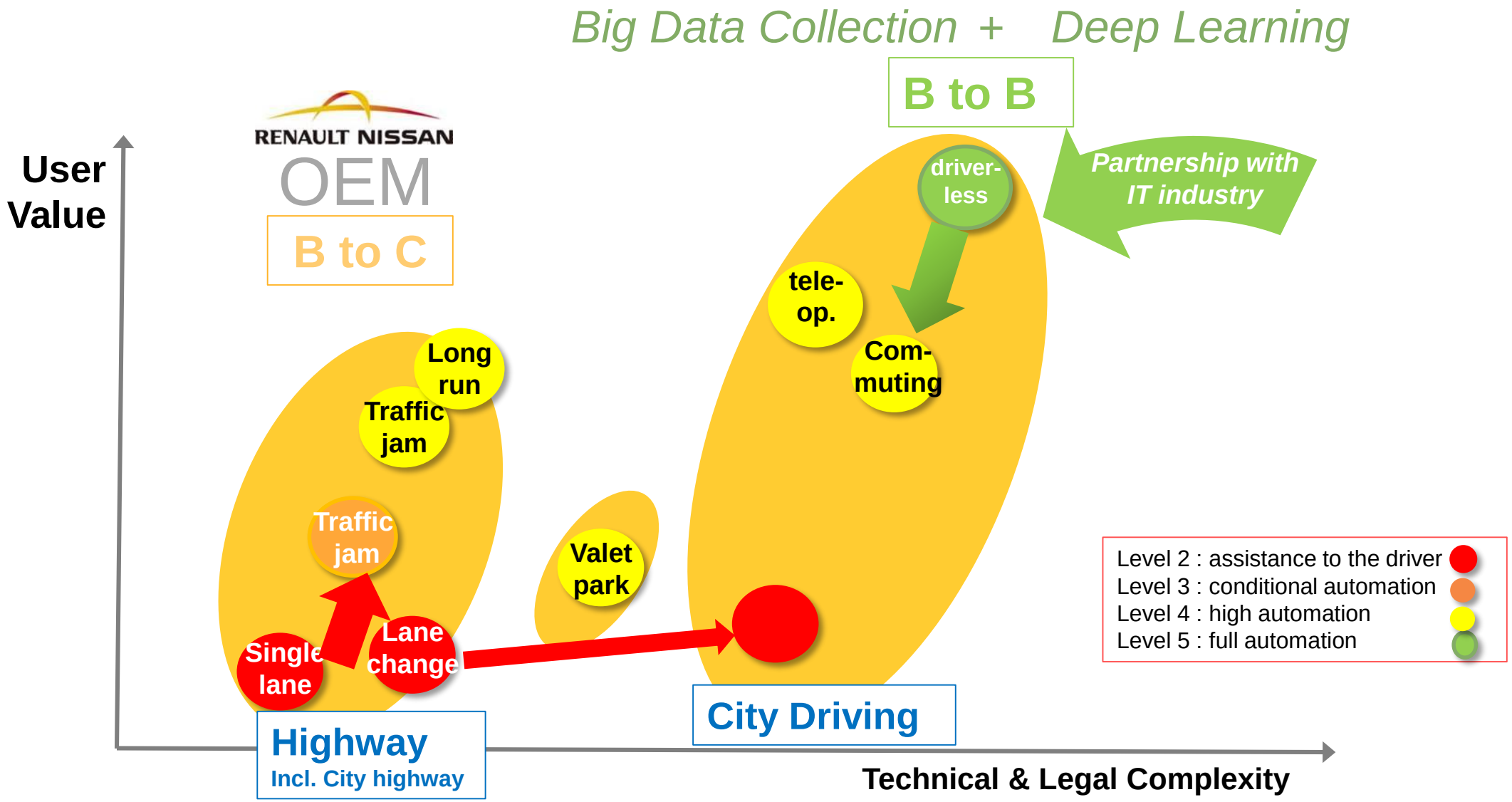



TRUE AUTOMATION STARTS FROM LEVEL 3 (SAE)



*terms acc. to SAE J3016

TWO MAJOR FIELDS FOR AUTOMOTIVE CAR MAKERS



RENAULT VISION FOR AUTONOMOUS DRIVING

AUTONOMOUS DRIVE

MANUAL DRIVE

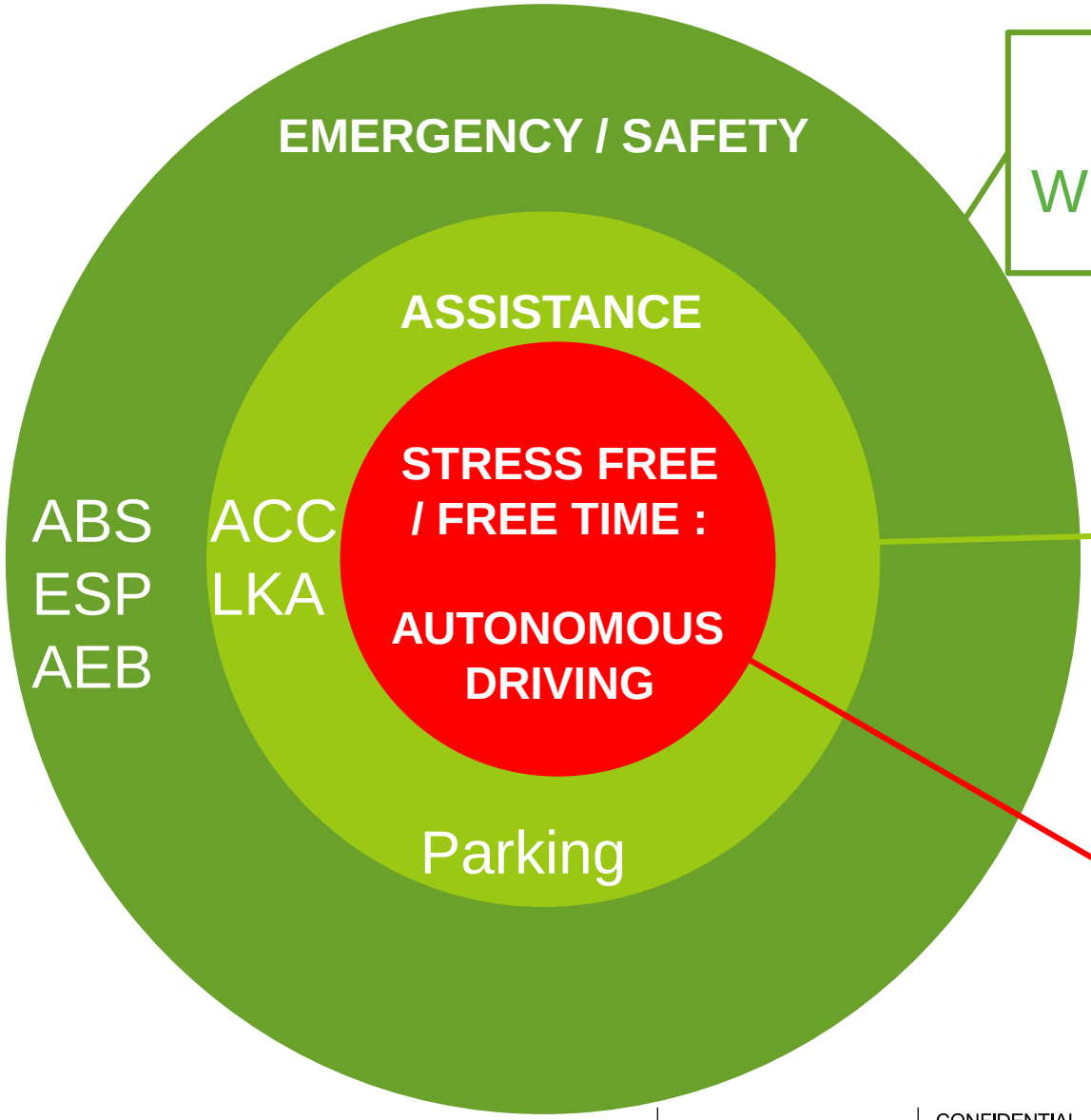
SAFETY BENEFIT

STRESS-FREE BENEFIT

FREE TIME BENEFIT

DRIVING PLEASURE

AUTONOMOUS DRIVING BEYOND ADAS



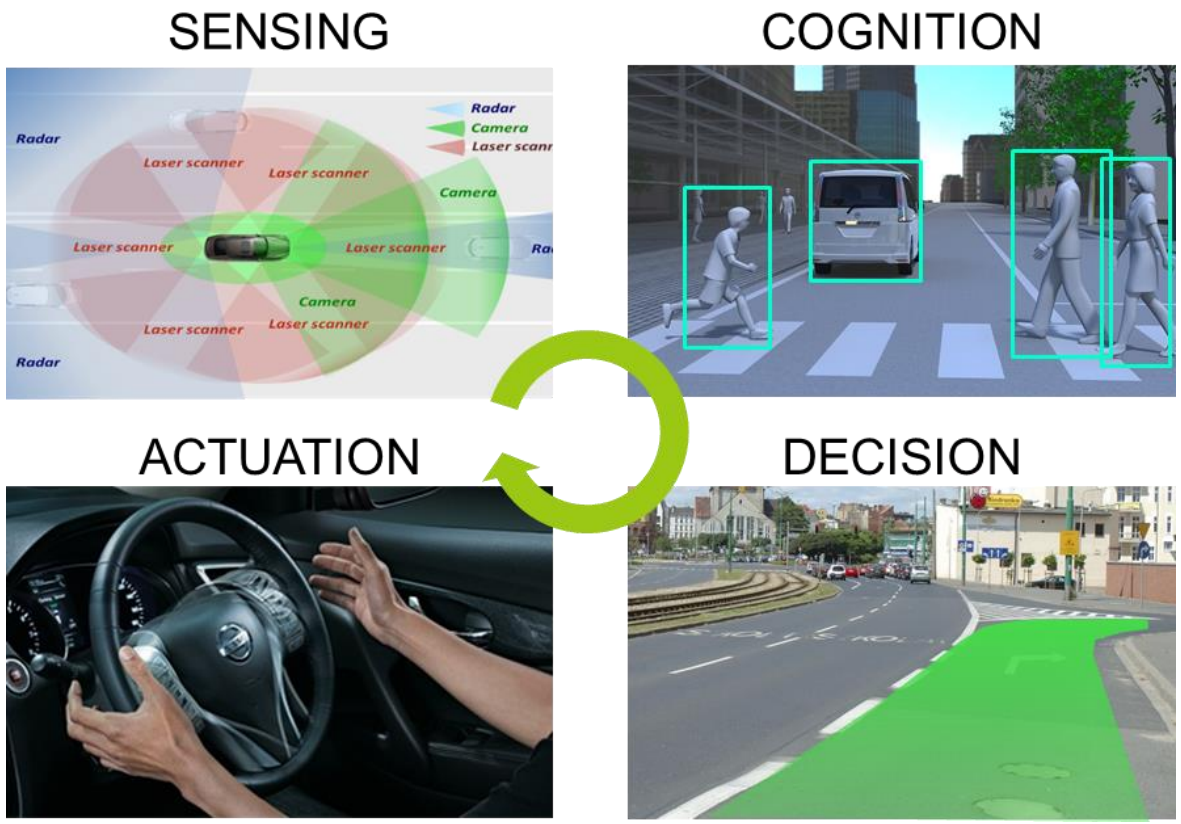
Continuously active
Without driver intervention

Only active under driver's request

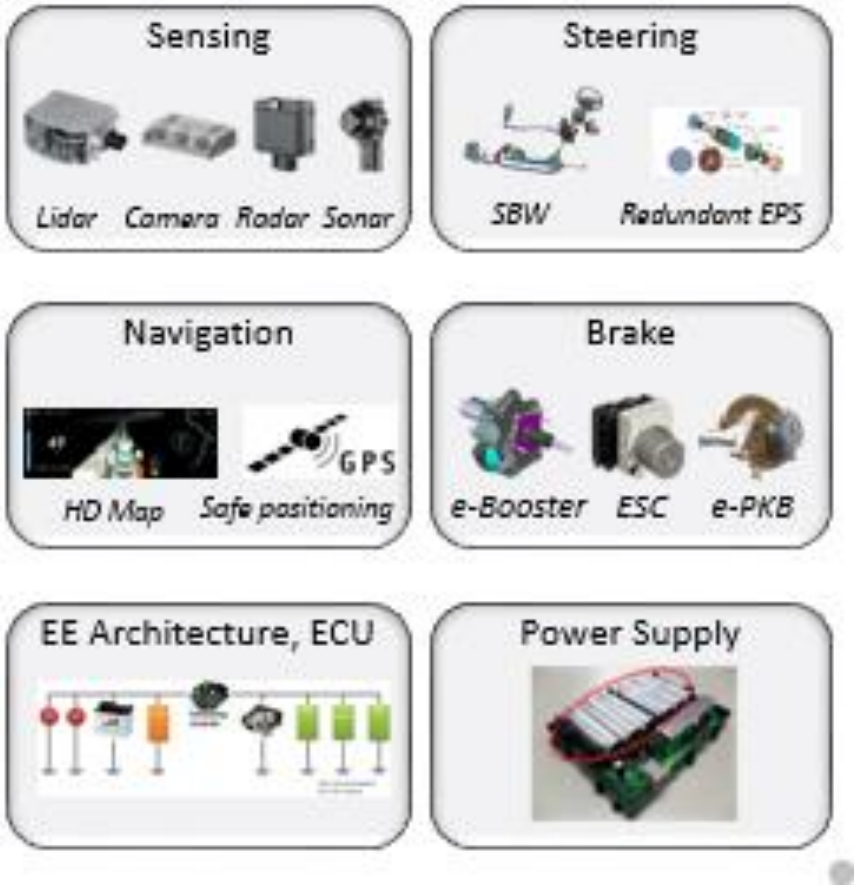
Active only in limited conditions and vehicle proposal

THE NECESSARY TECHNOLOGY FOR AD

Core technologies



Redundancy



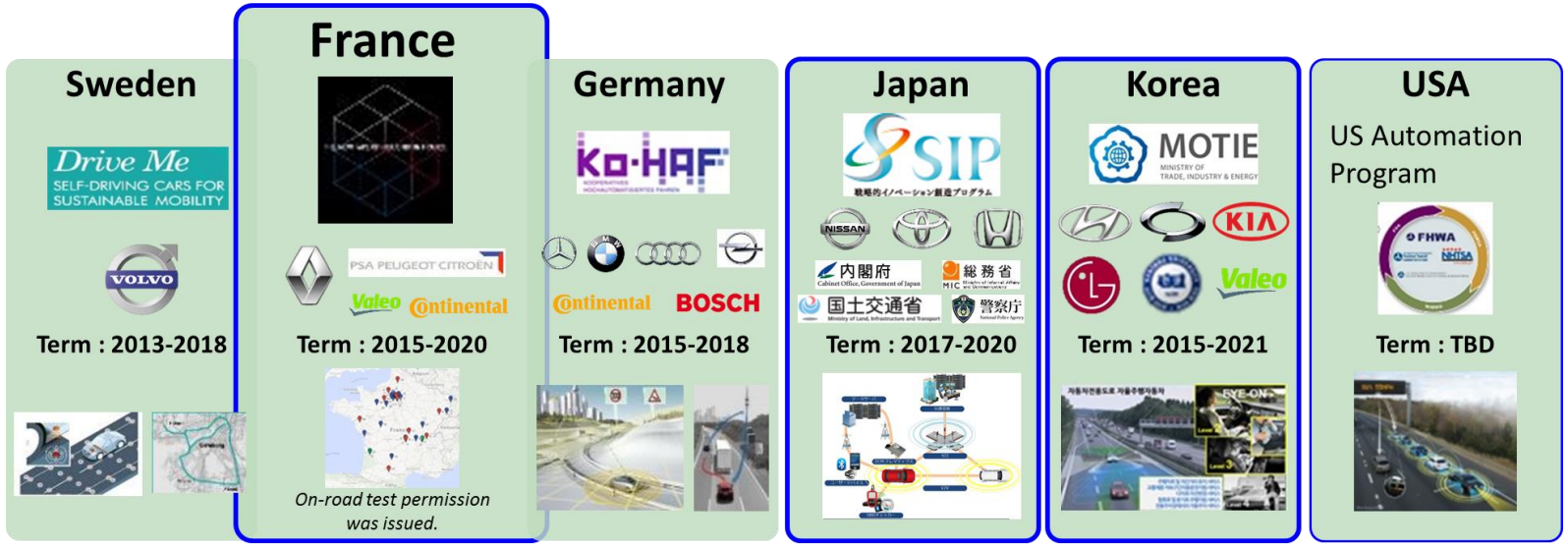
SUCCESS CONDITIONS : SOCIAL ACCEPTANCE

Social acceptance

- Regulations
- Product Liability
- Infrastructure
- Insurance
- Consumer awareness
- Driver Education

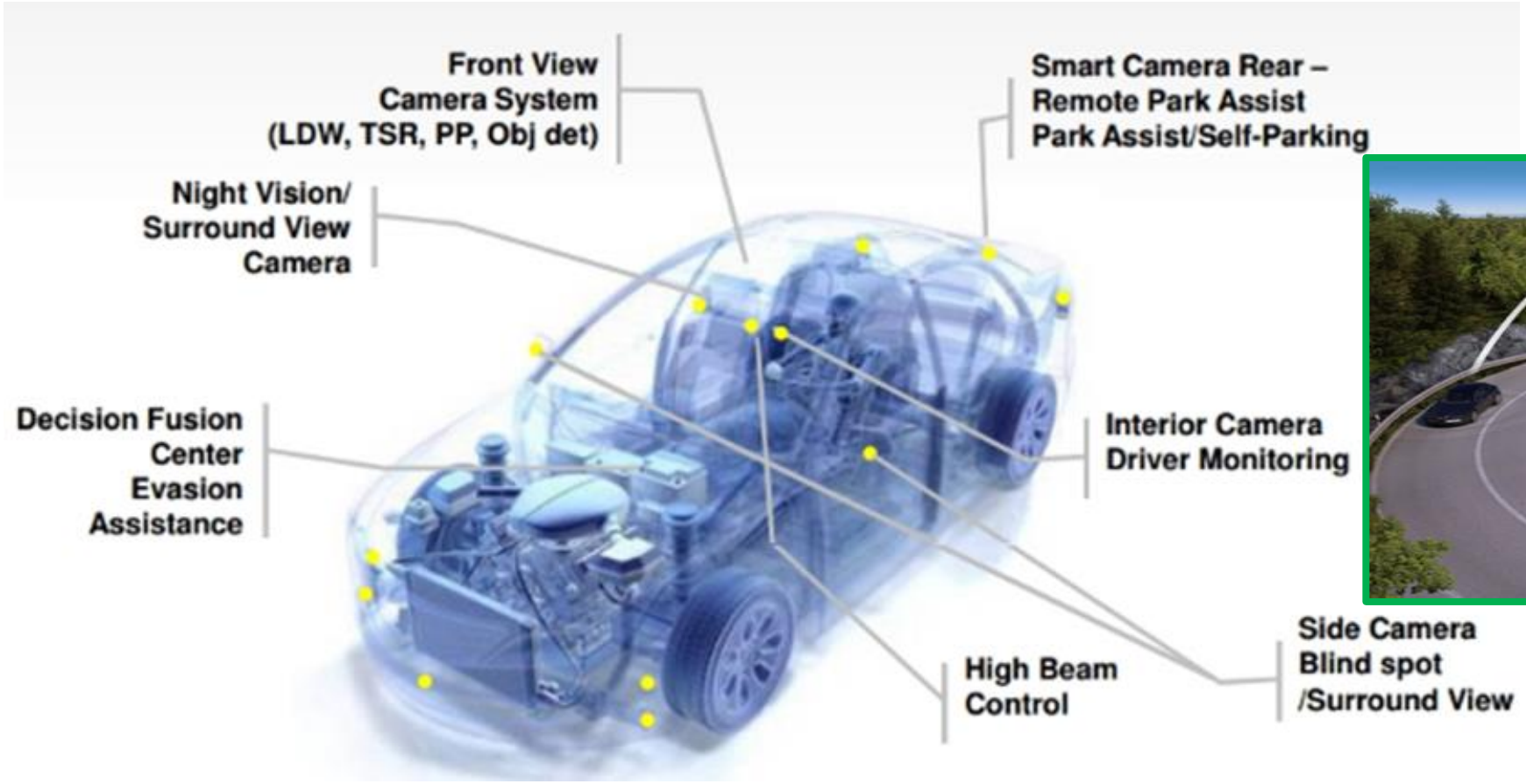
Experimentation

- Proof by FOT on certified roads



THE MAJOR STAKE IS SAFETY

SYSTEM OF SYSTEM & LOCALIZATION



AD IS A MAJOR DISRUPTION

ADAS
(L1, L2, L3)

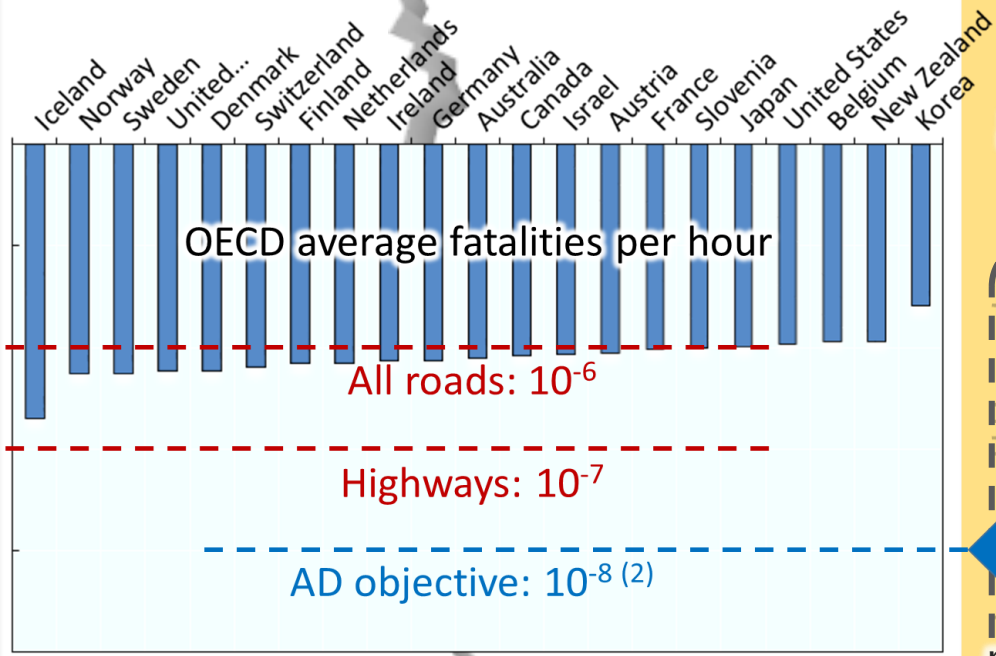
Driver is the last resort

Driver reliability proof

Driver training + experience

(1) *Emerging German L3 standard (Audi, BMW, Daimler)*

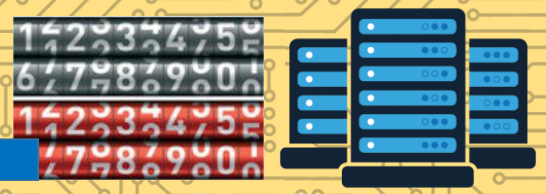
(2) *Tentative consensus among European OEM*



AD
(L3+(1), L4, L5)

System is the last resort

System reliability proof

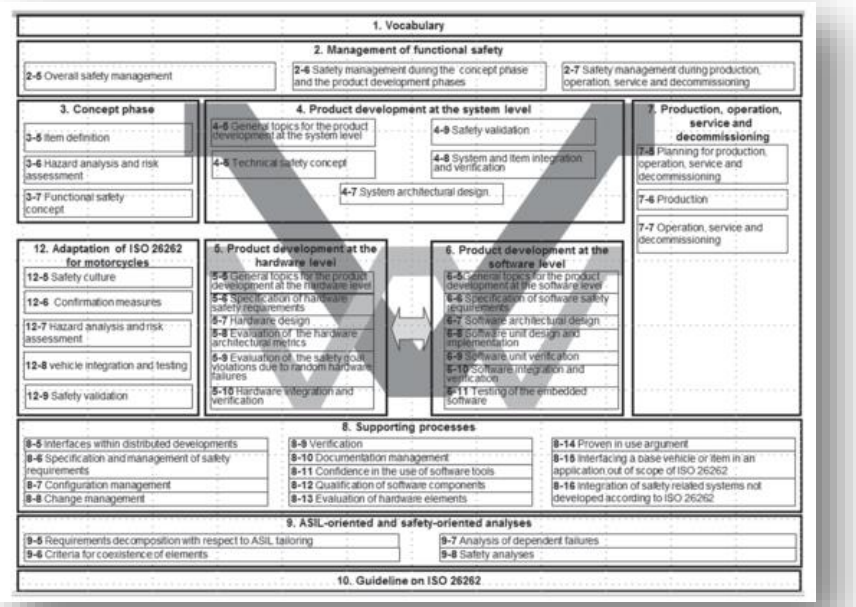


Massive
mile accumulation + resimulation

SAFETY DEVELOPMENT AND VALIDATION

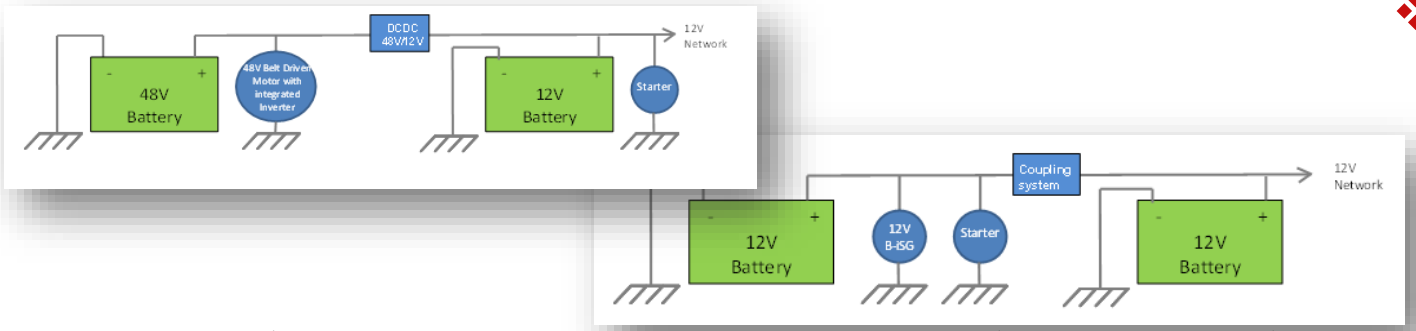
ISO 26262 defines how to assess a risk and the necessary activities to perform for each step:

- System
- Software
- Hardware
- Production...



Redundancy for Autonomous Driving:

- Redundant Sensors & Actuators
- Redundant Communication Networks
- Redundant Power supply Networks



- **Additional Safety Stakes:**
  - For Autonomous Driving, Automotive EE Architecture has to switch from Fail Safe design to Fail Operational.
  - Safety has also to consider SOTIF (Safety of the Intended Functionality)

SAFETY & SOTIF

Does a camera can identify a target in a very large roundabout without lane ?

Does a radar will be accurate on a metallic bridge ?

Does an ultrasound sensor can detect a child with a wool sweater?

ISO 26262 Standard is necessary but not sufficient !

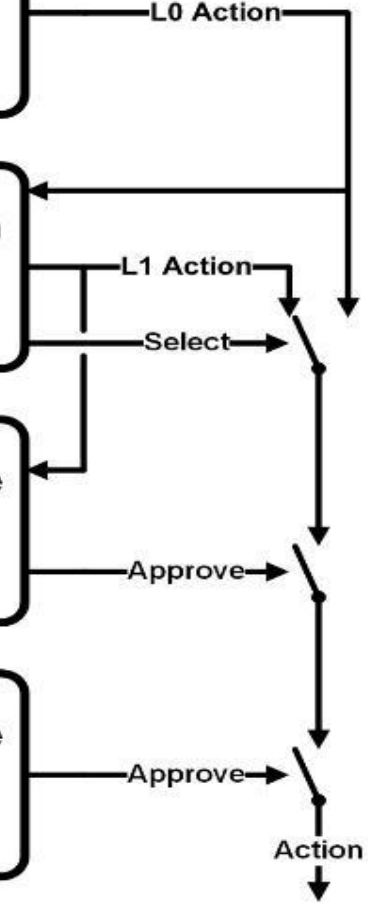
E

FIRST CONDITION : E/E ARCHITECTURE BASED ON 4 LAYERS TO ENSURE ASILD

evolutive

proven

	Layer	Function	Safety	ASIL	Arbitration
Layer 0	Neural Network	Smooth & fuzzy human-like driving	May manage unexpected scenes (not proven)	QM	Favorite action
Layer 1	Command SoftWare	Discrete & deterministic robot-like driving	Stay inside safe operating domain	ASIL A	Apply L0 action if consistent with L1 action
Layer 2	Monitoring SoftWare	Consistency check	Check SoftWare integrity	ASIL C	Go to safe state if L1 action inconsistent
Layer 3	FirmWare & HardWare	Autotest	Check HardWare integrity	ASIL D	Go to safe state if HardWare failure

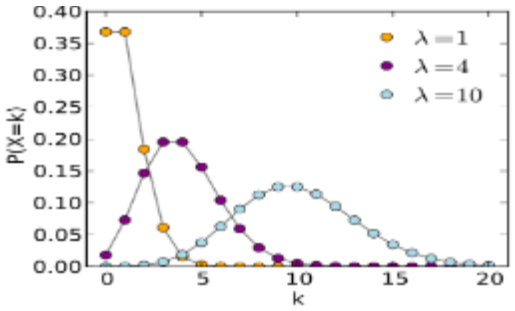


SECOND CONDITION :THE VALIDATION STRATEGY TO DEMONSTRATE ASIL D

I Statistical safety threshold

Order of magnitude for validation :
20 Billions of kms

Non affordable by physical test drive



II Reduction : Experience plan + Simulation

Targetted, iterative physical test drive

Numerical simulation

III Road sections criticity inductors

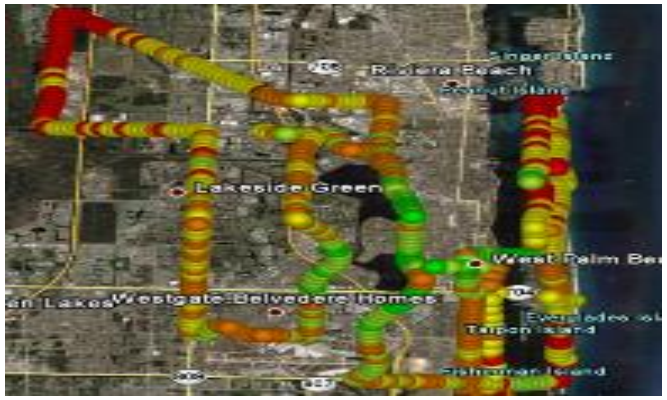
For each road section, calculate the « criticity cube » : Nb incoming lanes x Nb exits x Strong Curvature …

IV Map of road sections with criticity

Each road section is ranked by its criticity ratio = criticity cube volume / average criticity

V Clustered road tests

Distribution of clusters is proportional to the criticity ratio of the road sections



VI Final proof of reliability

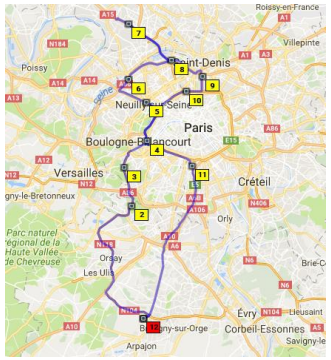
Reliable and efficient validation
<<< 20 Billions km

JOINT PRECOMPETITIVE WORKS IN FRANCE

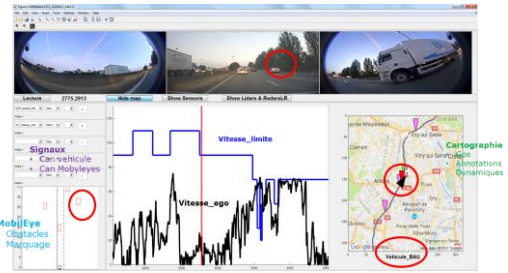
SCENARIO IDENTIFICATION (MOOVE PROJECT)

1. Real world driving safety critical scenarios (SCS)
2. SCS occurrence statistics
3. New SCS

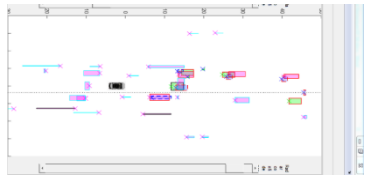
0.
Use case Definition & Targeted scenarios



1. Data collect



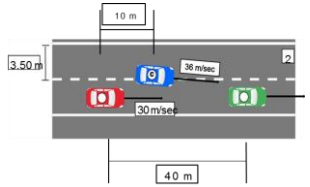
2.
Data transformation at common format



3.
Calculation of high level parameter (Sensors independant)

- Relative_Velocity_X
- Relative_Velocity_Y
- Absolute_Velocity_X
- Absolute_Velocity_Y
- Relative_Accel_longi
- Accel_longi
- .....
- Time_To_Collision
- Time_Between_Vehicles
- Status_Mobile
- Pos_X
- Pos_Y

4.
Scenario searching and clustering



DIGITAL SCENARIO LIBRARY & TEST CASE GENERATION (SVA PROJECT)

1. Simulation platform
2. Digital Scenarios library

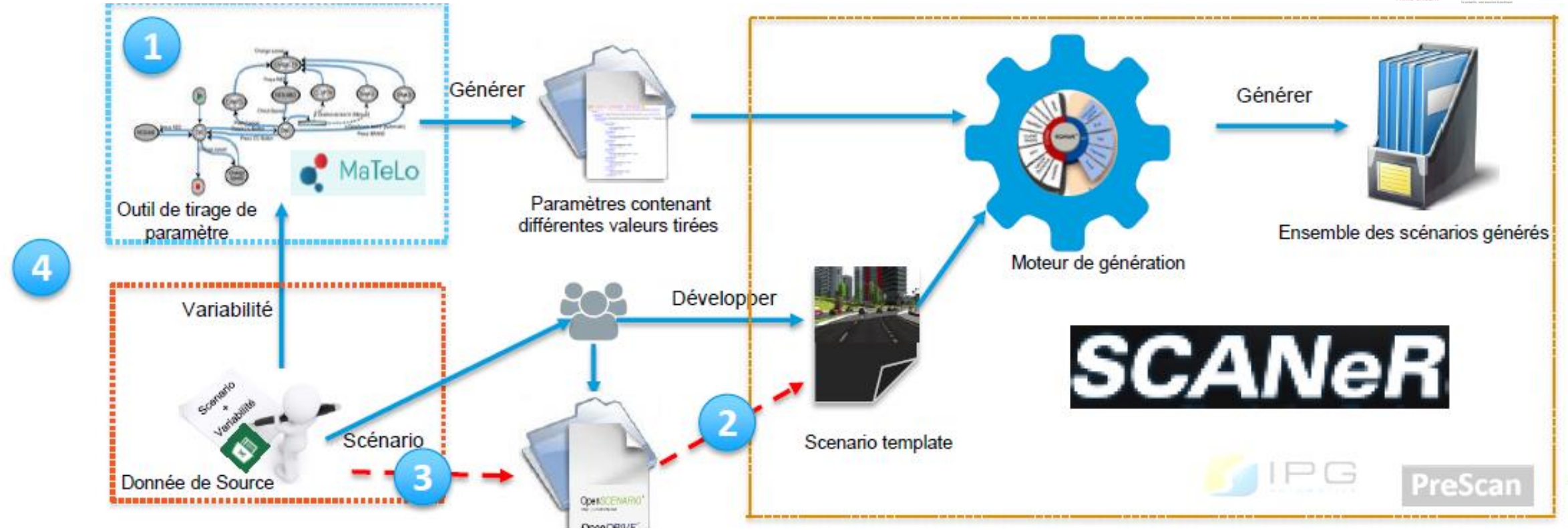
SVA

Industrial partners

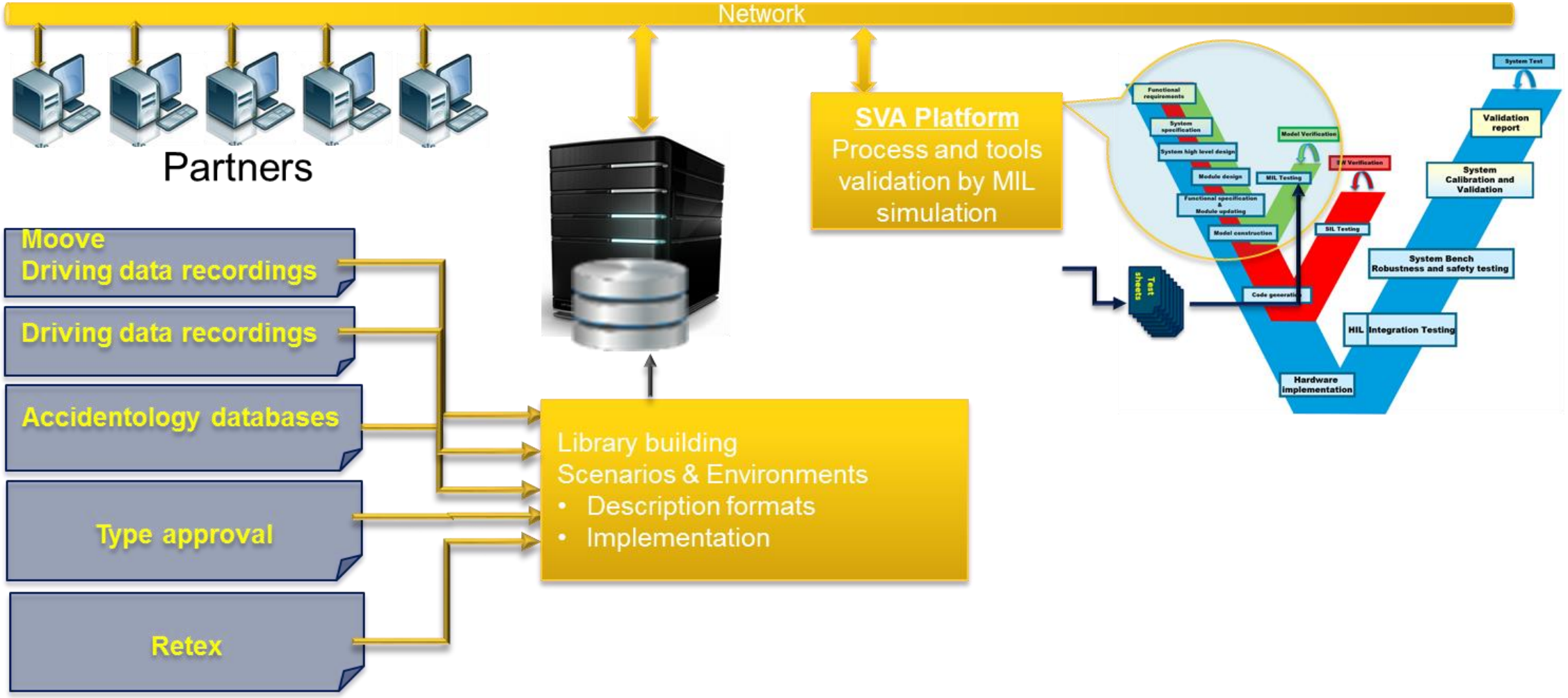
PSA PEUGEOT CITROËN · RENAULT · Continental · Valeo · OKTAL · ALL4TEC · assystem · OPTIS · apsys · sector group

Academic partners

université PARIS-SACLAY · LNE · LSV · CEA



DIGITAL SCENARIO LIBRARY IMPLEMENTATION



CONCLUSION

AUTONOMOUS & CONNECTED OFFER BY 2022

CONNECTED SERVICES

100% connected cars

AUTONOMOUS VEHICLES

15 models with autonomous driving technologies

MOBILITY SERVICES

marcel · Yuso Fleet · DeNA · KARHOO · transdev · RCI MOBILITY

Robot –vehicles operations

RENAULT IS ON TRACK!