



Autonomous Driving Validation

Eric Landel
Numerical Modeling & simulation
Groupe Renault

Autonomous Driving: more and more on stage



ADAS- AD : already a long story!



**Renault HMI 86
(vertical screen)
PrometheUS Project**



**Test Vehicle Renault 4L with
anti collision prototype radar**



RENAULT VISION FOR AUTONOMOUS DRIVING (Passenger Car)

AUTONOMOUS DRIVE

**SAFETY
BENEFIT**



**STRESS-FREE
BENEFIT**



**FREE TIME
BENEFIT**

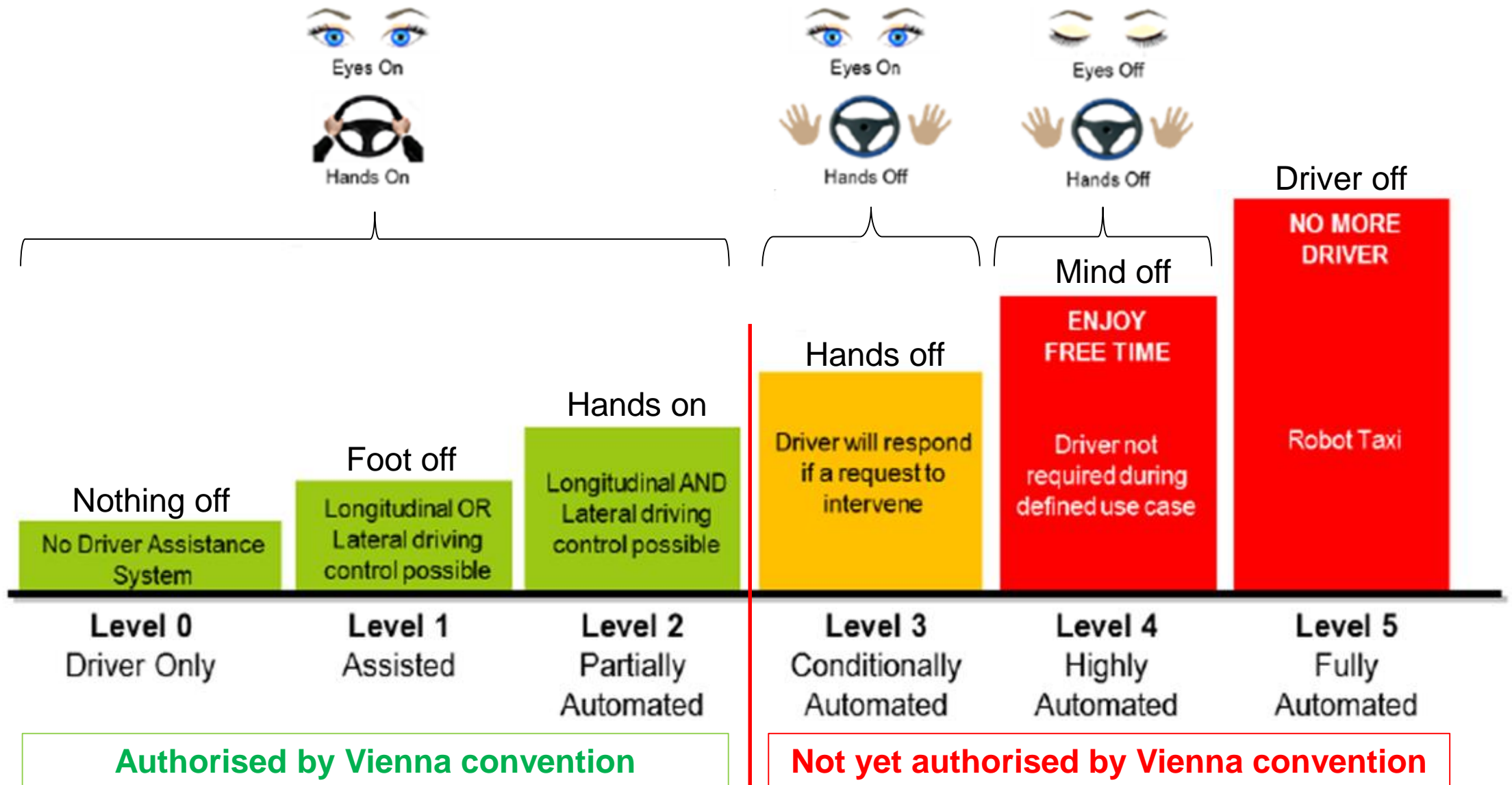


MANUAL DRIVE

DRIVING PLEASURE



TRUE AUTOMATION STARTS FROM LEVEL 3 (SAE)



Authorized by Vienna convention

Not yet authorized by Vienna convention

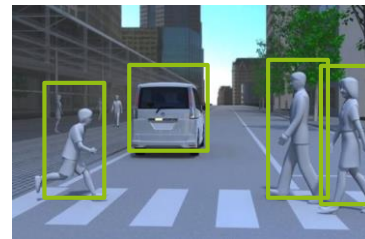
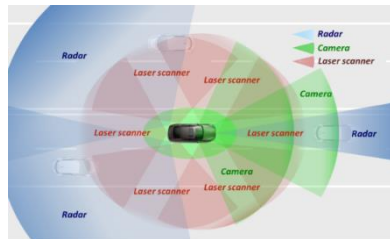
Reliable perception is key for AD & ADAS...



Detect

Understand & Decide
(all situations, human like behaviour)

Act & inform

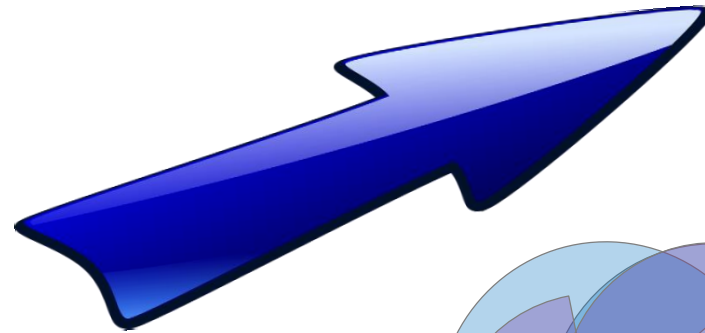


...and leads to numerous sensors integration!



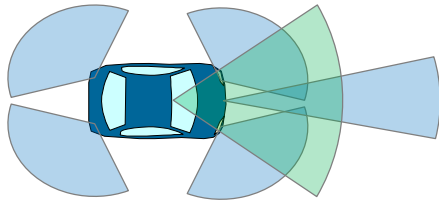
AD

Ca. **25** sensors



ADAS

1 to **6** sensors



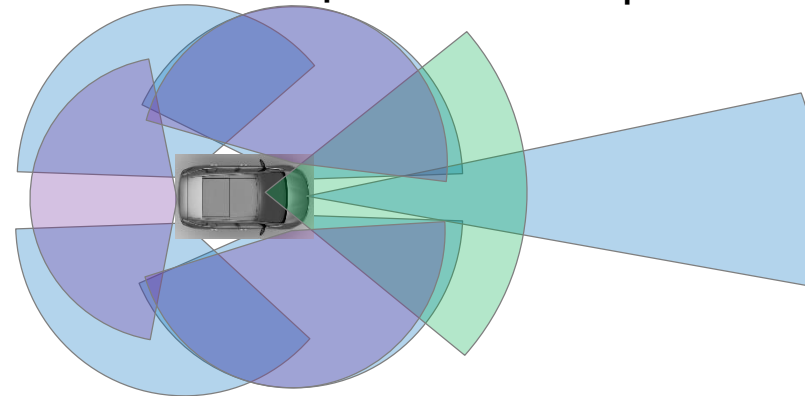
Up to 8 Cameras



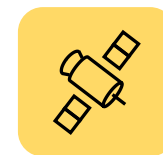
Up to 6 Lidars



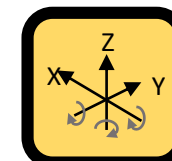
Up to 8 Radars



MAP High Definition



GNSS



IMU



Road DNA or REM

Validation



AD IS A MAJOR DISRUPTION

ADAS

(L1, L2, L3)



Driver reliability proof



Driver training + experience

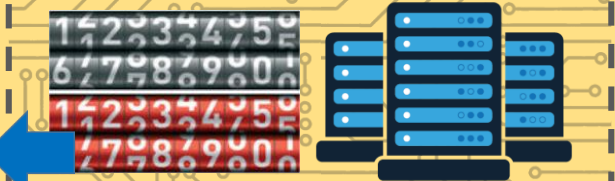


AD

(L3+⁽¹⁾, L4, L5)

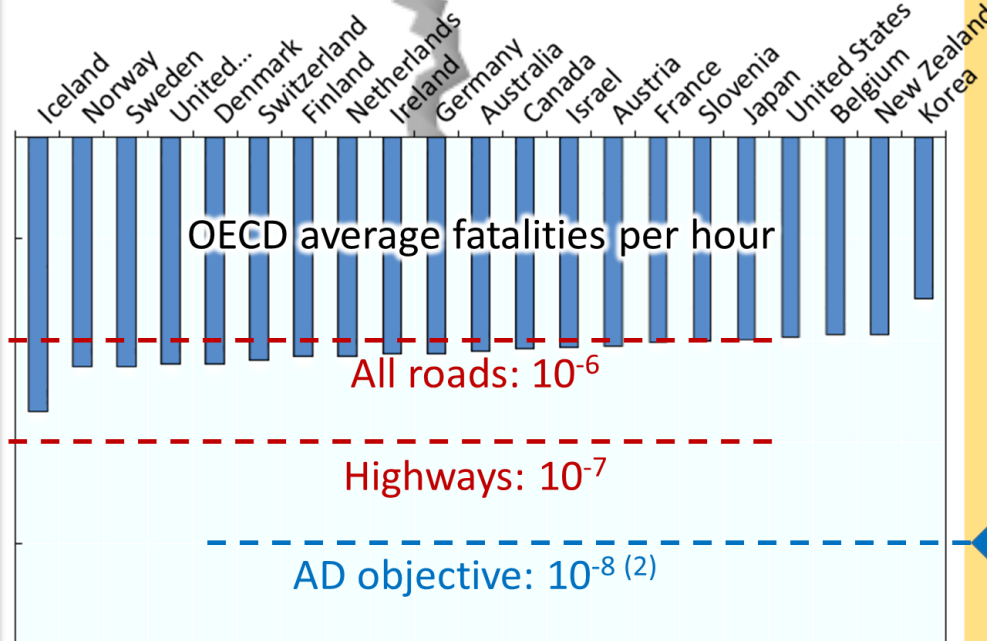


System reliability proof



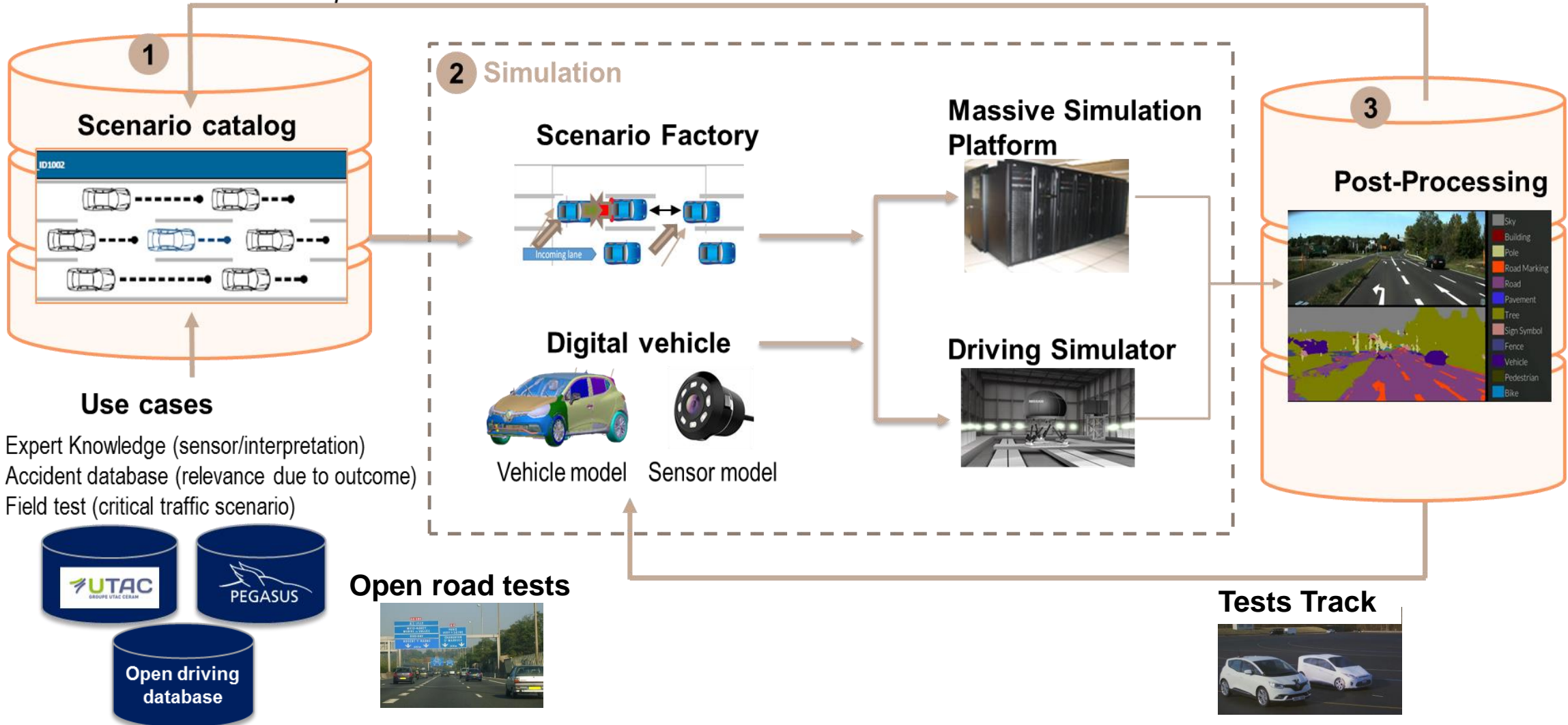
Massive mile accumulation + simulation

- (1) Emerging German L3 "standard"
- (2) Tentative consensus among European OEM



Alliance has developed a validation chain of autonomous vehicles

Capitalization



- Expert Knowledge (sensor/interpretation)
- Accident database (relevance due to outcome)
- Field test (critical traffic scenario)

Open road tests

Tests Track



ERIC LANDEL

JUNE 2019

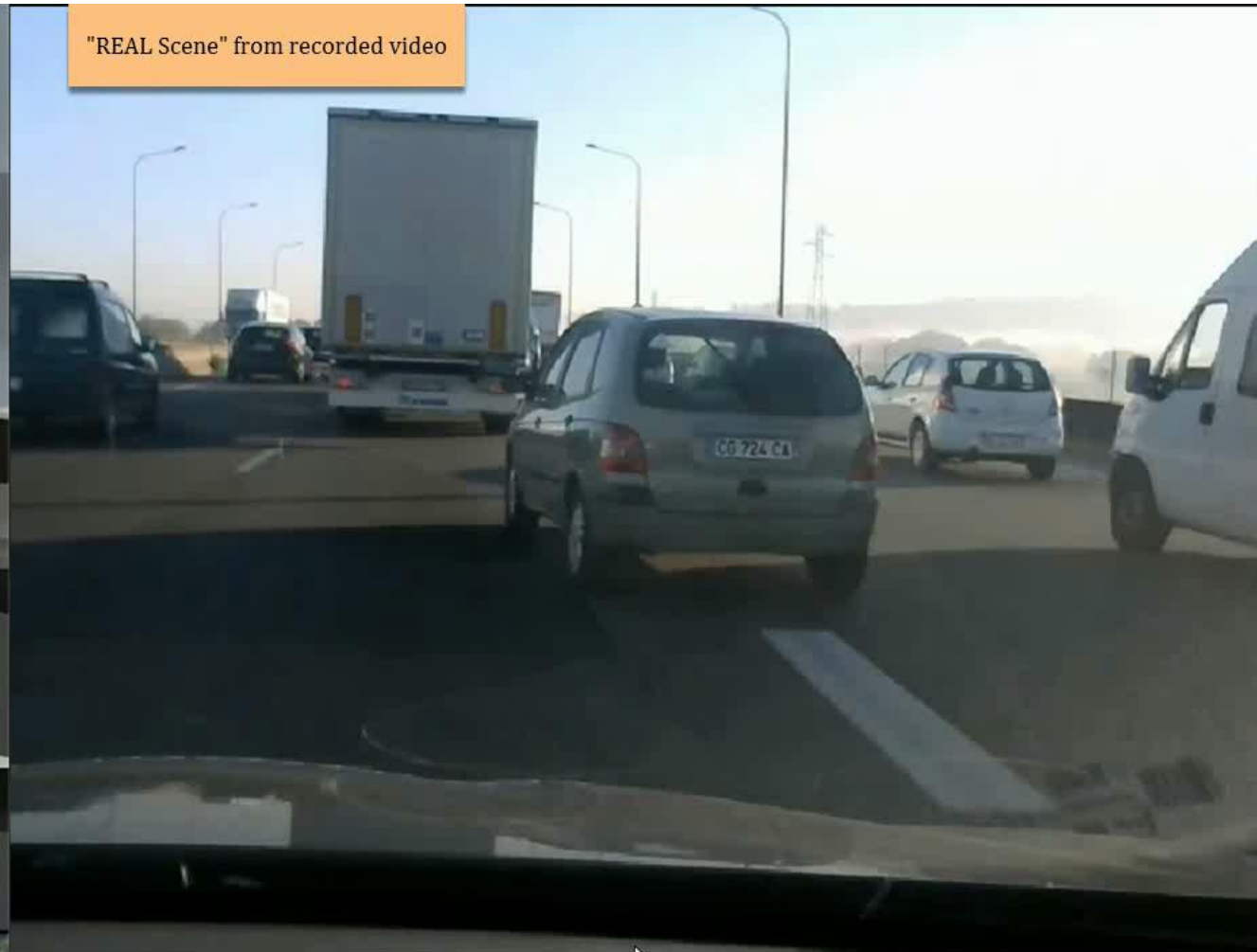
CONFIDENTIAL ©
PROPERTY OF GROUPE RENAULT

11

GROUPE RENAULT

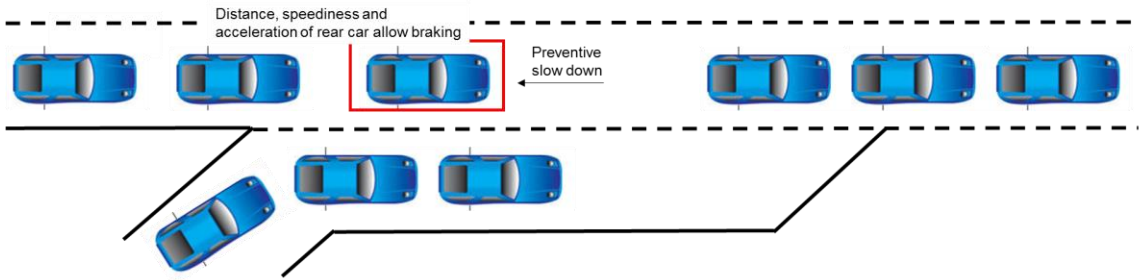
Confidential C

Interesting scene are digitalized and parametrized

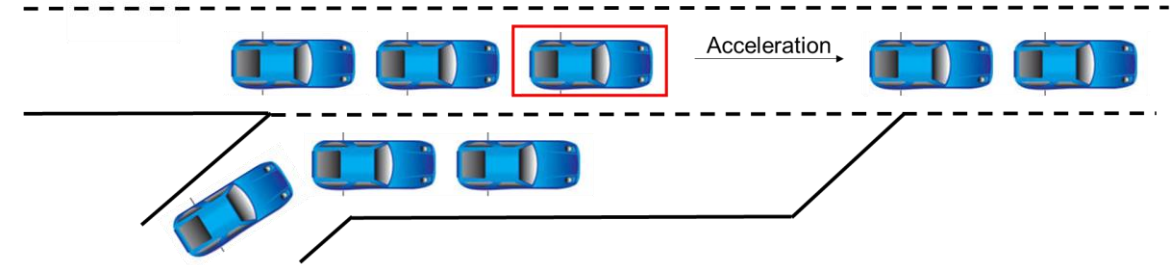


Scenario are various with many parameters and can be very complex

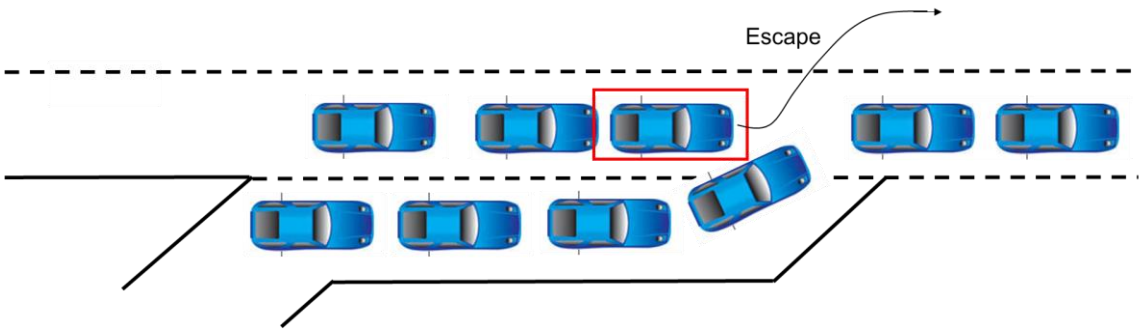
Variation 1: "Gentleman"



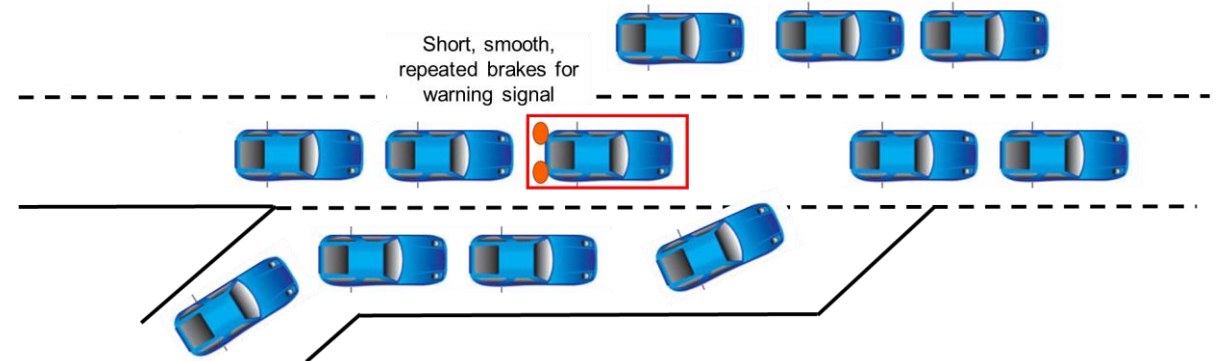
Variation 2: "in a hurry"



Variation 3: "Gentleman in a hurry"



Variation 4: "cautious gentleman"



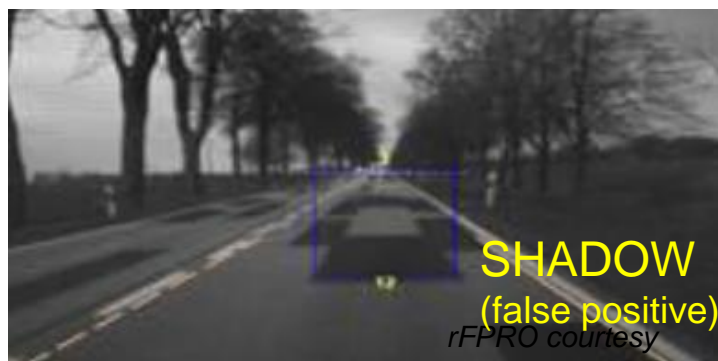
Sensors is a key point :key point for validation and modeling

- **Weather conditions perturbations**

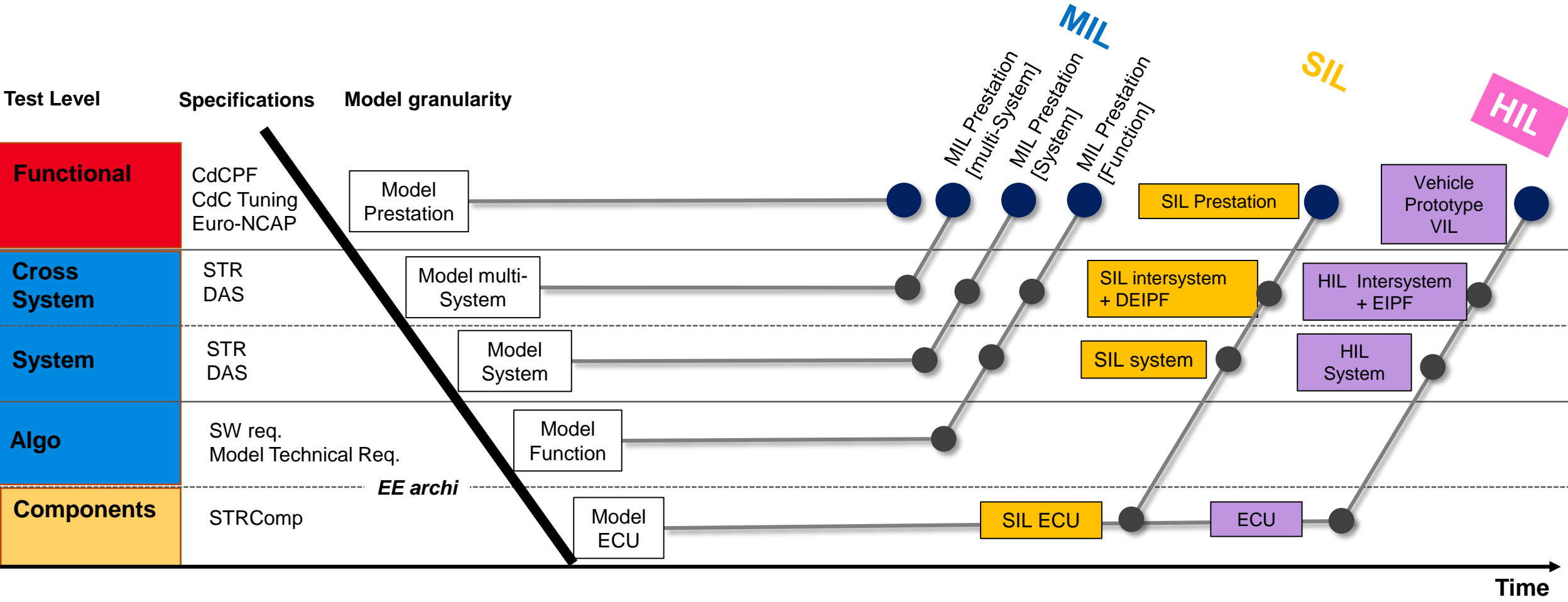
- Rising sun
- Spray
- Heavy rain
- Snow
- Fog
- Night
- Shadow
- ...

- **Integration on the vehicle**

- **Life cycle reliability (cleaning, moisture, ...)**

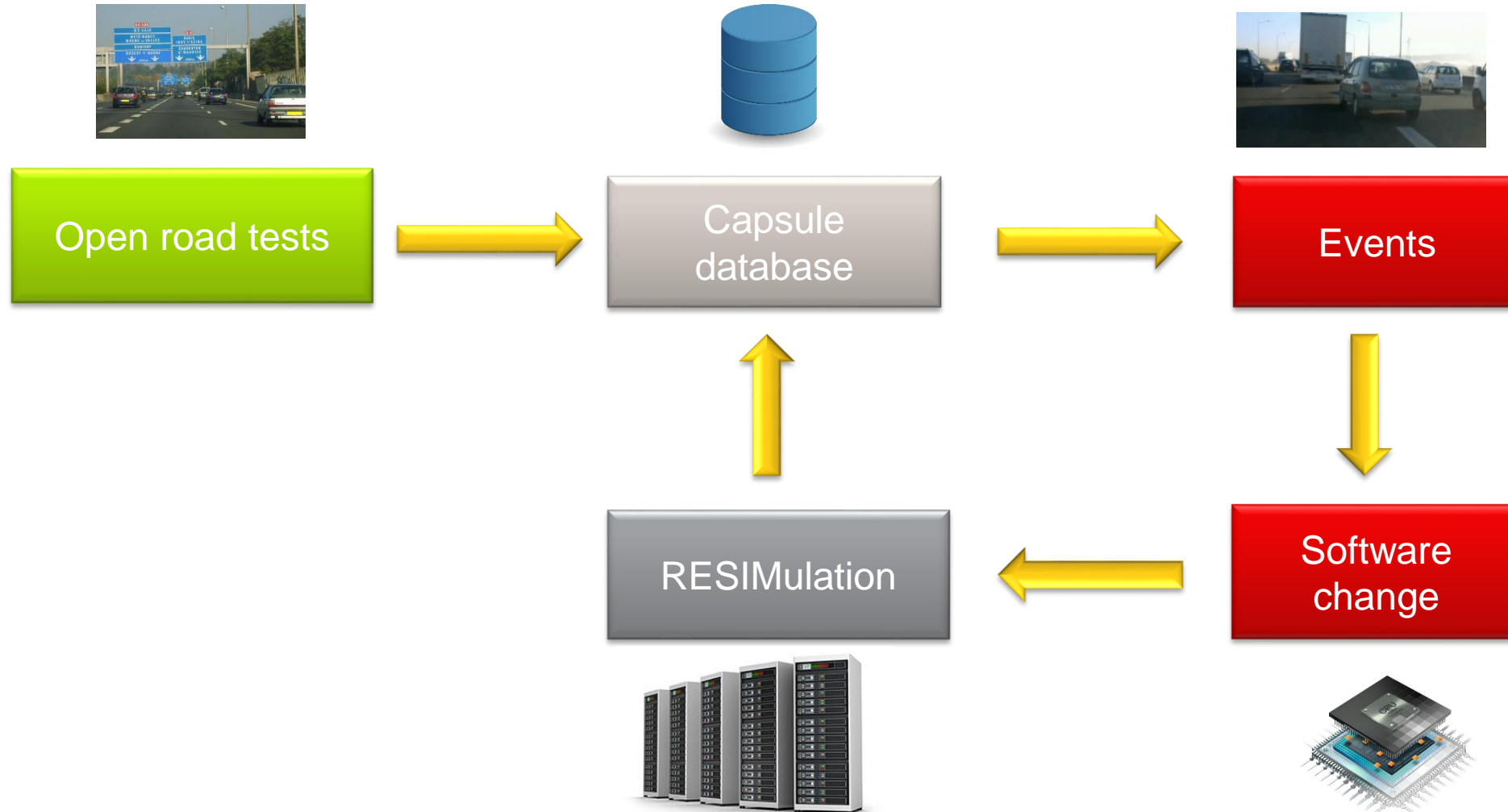


Verification & Validation Process involves several steps with XIL tools



Resimulation: powerfull tool during & after development

Ensure control SW update with no-regression through "RESIMulation"



Events :

- False positive
- False negative
- Lack of performances

CONCLUSION

The technology is promising

But strong increase of complexity

Validation by a mix of tests and simulation

Sensors modeling is a critical point



Thank You for your attention

