



Lidar vs. HD Radar

Competition or Complementarity for L3+ Autonomous Driving?

19 November 2025

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DVN SENSING & APPLICATIONS CONFERENCE 2025

FROM L2 TO L3: THE RESPONSIBILITY SHIFTS

Level 2 (Assistance)

- The driver is 100% responsible and must supervise the system at all times ("Eyes-on").
- Overtrust in L2 systems can be dangerous as the driver is the ultimate fallback.

Level 3+ (Conditional automation)

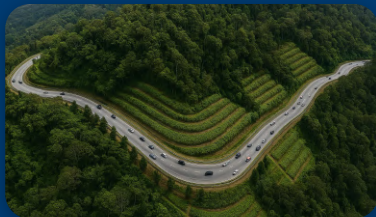
- The system is 100% responsible within its Operational Design Domain (ODD).
- The driver becomes a "fallback-ready user"

L3+ AUTOMATED DRIVING SYSTEM MUST SAFELY HANDLE ALL SCENARIOS INCLUDING RARE EDGE CASES

1. ALKS refers to Automated Lane Keeping System
2. ODD refers to Operational Design Domain

NEED TO MANAGE COMPLEX REAL WORLD USE CASES

Curvy & hill highway



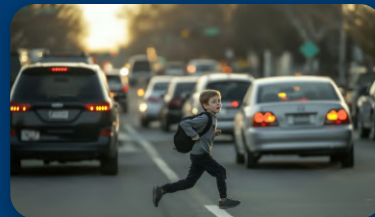
Trash and people on road



Lost cargo on dense traffic



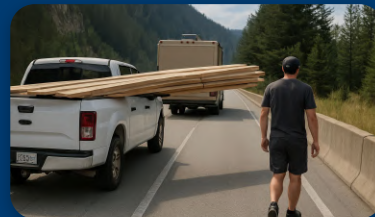
VRU behind vehicle



Sudden object on rural and urban roads



Overhanging loads



**SAFETY DEMANDS RELIABLE PERCEPTION: ZERO FALSE NEGATIVES.
USER ACCEPTANCE REQUIRES MINIMUM FALSE POSITIVES.**

WHY ONE SENSOR TYPE ISN'T ENOUGH?



Camera

The human-like Perception

Excellent in Recognition of colours, shapes and classification of objects

Sensitive to adverse weather (heavy rain/fog) and low light/glare

Can be fooled by 2D visual illusions.



HD Radar

The All-Weather Velocity Expert

Excellent in bad weather & provides a native velocity information

Lower resolution vs Lidar and Camera

Struggle for Objects separability



Lidar

The Resolution Champion

Provides excellent resolution & accuracy

Native freespace detection

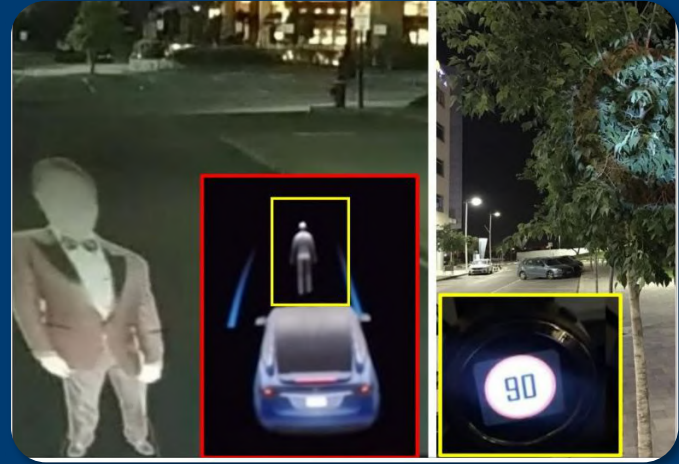
Precise 3D environment mapping & object recognition

Performance can be affected by heavy fog, rain, or snow

SENSORS REDUNDANCY REQUIRED

1. ALKS refers to Automated Lane Keeping System
2. ODD refers to Operational Design Domain

WE DRIVE IN A VISUAL ENVIRONMENT



**CAMERA PERCEPTION IS MANDATORY
BUT...COMPUTER VISION HAS ITS CHALLENGES → E.G VISUAL ILLUSIONS
CAN FOOL CAMERA**

UNECE R157 REGULATION FOR ALKS ⁽¹⁾

↔ Minimum forward detection range defined by regulation

Highway: 150m at 130 kph



Must consider small objects
→ "**passable object**"

Range: ~150-200m

FoV: ~120° x 25°

Resolution: ~0.05°



Must **detect and compensate** for **environmental conditions** that **reduce the detection range** depending on the defined ODD⁽²⁾

UNECE R157 L3 most stringent Front Perception scenario is **lost cargo** which requires a detection range between **150-200m**



THE SOTIF CHALLENGE: "LOST CARGO" !

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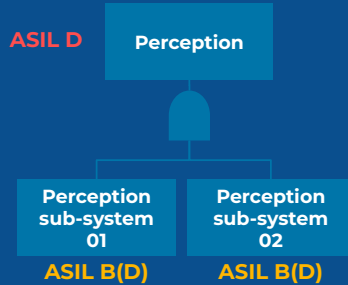
LOST CARGO PERCEPTION REQUIREMENTS SYNTHESIS

Functional Safety

Undesired Event / Hazardous Behaviour
 "Lack/Loss of deceleration command"

⇒ Safety Goal: **ADS shall provide sufficient deceleration [ASIL D]**

ISO 26262 ASIL decomposition 2 Sensors
ASIL B(D) assuming no Common modes



SOTIF

Very stringent perception target for
 Lost Cargo detection: **1.70E-07 FN event / h**



Breakdown of perception into at least 2 independent paths is needed to **avoid billions of kms to be driven**



UNECE R157

Detection Range mini = **150 m**

Det. Range Maxi = **[221-252] Smooth**
[168-208] Hard
[122-174] Heavy

130 km/h	① Lane Change <small>no lane change in view</small>	② Shift in Lane	③ Stop in Lane <small>(Braking)</small>	④ Evasive Lane Crossing
Option 1 Smooth <small>Manoeuvre</small>	225 m Max deceleration = 3.5 m/s ² <small>Speed reduced to 80 km/h</small>	221 m Max deceleration = 3.5 m/s ² <small>Speed reduced to 80 km/h</small>	222 m Max deceleration = 3.5 m/s ²	43 m No deceleration <small>No speed reduction</small>
Option 2 Hard <small>Manoeuvre</small>	208 m Max deceleration = 4 m/s ² <small>Speed reduced to 80 km/h</small>	191 m Max deceleration = 4 m/s ² <small>Speed reduced to 80 km/h</small>	168 m Max deceleration = 3.5 m/s ²	43 m No deceleration <small>No speed reduction</small>
Option 3 Heavy <small>Manoeuvre</small>	122 m No deceleration <small>No speed reduction</small>	174 m Max deceleration = 4.5 m/s ² <small>Speed reduced to 80 km/h</small>	133 m Max deceleration = 4 m/s ²	43 m No deceleration <small>No speed reduction</small>

Passable [≤ 15x50] / Non-Passable [> 15x50]

[15x50] **Horizontal Resolution = 0.05°/p**
Vertical Resolution = 0.05°/p

VERY STRONG PERCEPTION REQUIREMENTS

VALEO SCALA™ 3: LONG RANGE CAMERA-LIKE LIDAR

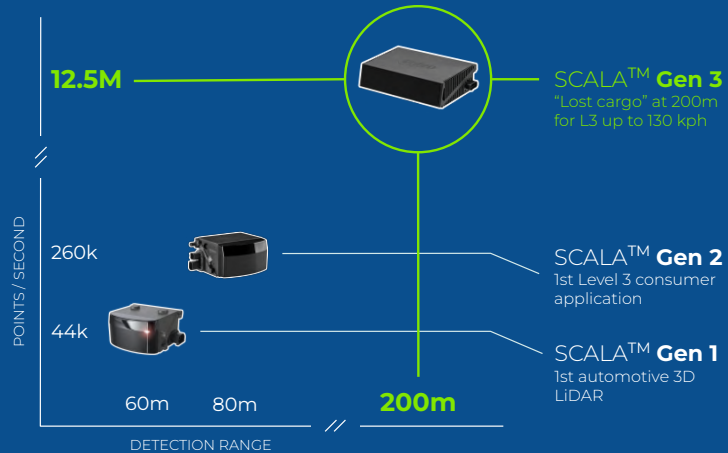
Key strength: high-resolution 3D point cloud

This is the sensor that solves the "Lost Cargo" problem.

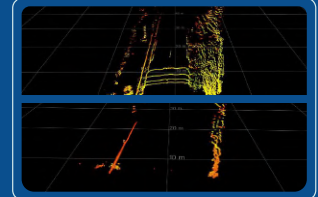
Accurately classifies small, static objects (the tire).

Measures shape and position with centimeter-level accuracy.

Works perfectly in all light conditions (total darkness, tunnels).



Complete perception SW stack



LIDAR: THE RESOLUTION CHAMPION THE SENSOR THAT SOLVES THE "LOST CARGO" CHALLENGE

HD IMAGING RADAR - THE ALL-WEATHER VELOCITY EXPERT

HD Radar provides unique strengths that Lidar and cameras lack

It is essential for SOTIF in dynamic and all-weather scenarios.

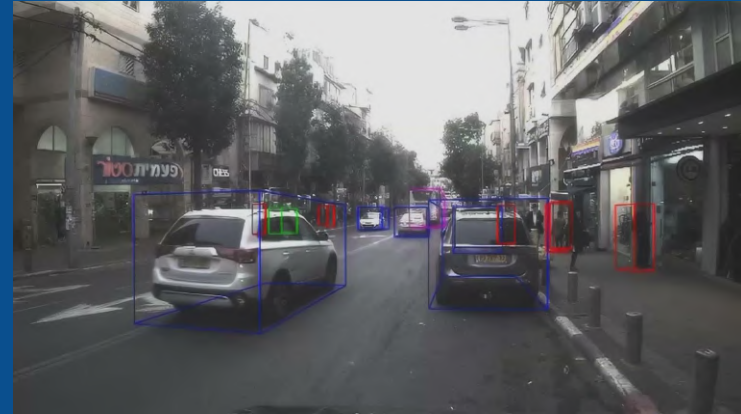
Measures relative velocity natively (Doppler).

Critical for "cut-in" and "cut-out" scenarios.

Unmatched performance in adverse weather (heavy rain, fog, snow).

Valeo

in
mobileye™



Bounding boxes generated by Radar Data only. No second sensor input required.

**HD RADAR: THE ALL-WEATHER VELOCITY EXPERT
ESSENTIAL FOR SOTIF IN DYNAMIC AND ALL-WEATHER SCENARIOS**

BONUS : THERMAL CAMERA - THE THIRD EYE

Thermal Camera: Providing redundancy in low visibility

Extending the ODD for VRUs and animals

Detects pedestrians, animals, and VRUs by their heat signature.

Immune to sun glare, headlight glare, smoke, and fog.

Works in complete darkness, seeing "what's in the shadow."



Valeo



Key Features

- ASIL B LWIR VGA camera (640x512)
- World's smallest sealed VGA LWIR camera (21x21 mm width)
- Horizontal FOV: from 24° to 70°
- Shutterless camera
- Defrost function

THERMAL CAMERA: THE THIRD EYE EXTENDING THE ODD FOR VRUs ANIMALS MANAGEMENT

SAFETY - LOST CARGO / VRUS / OVERHANGING USE-CASES



Thermal Camera



HD Radar



HD LiDAR

Lost Cargo



Lost Cargo close to Fence / Guardrail



Lying Pedestrian



Overhanging Loads



SOTIF / PERFORMANCES / ADDED FEATURES



Thermal Camera

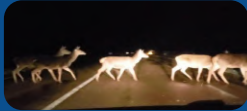


HD Radar

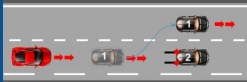


HD LiDAR

Animals / VRUs



Successive Front Vehicles
→ Cut-out



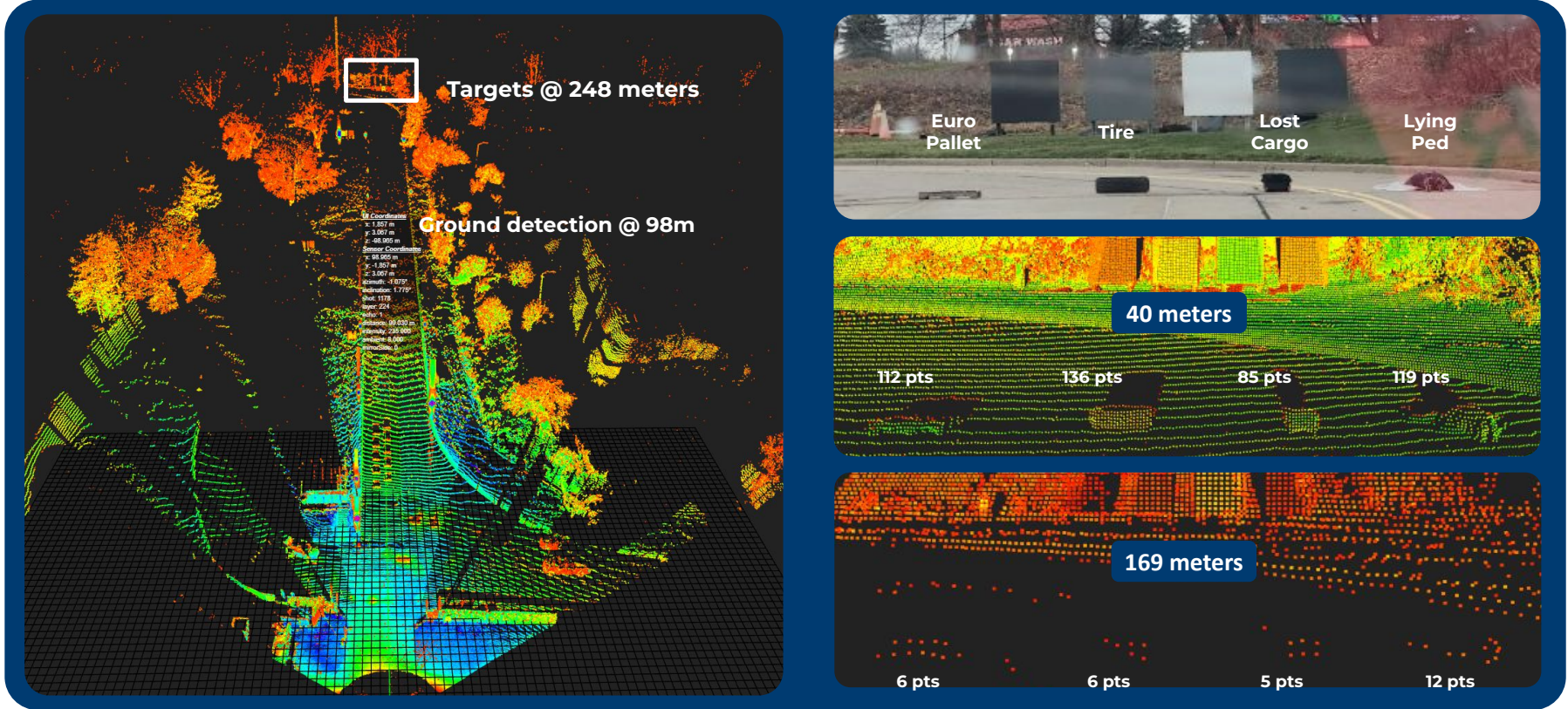
Objects Separability



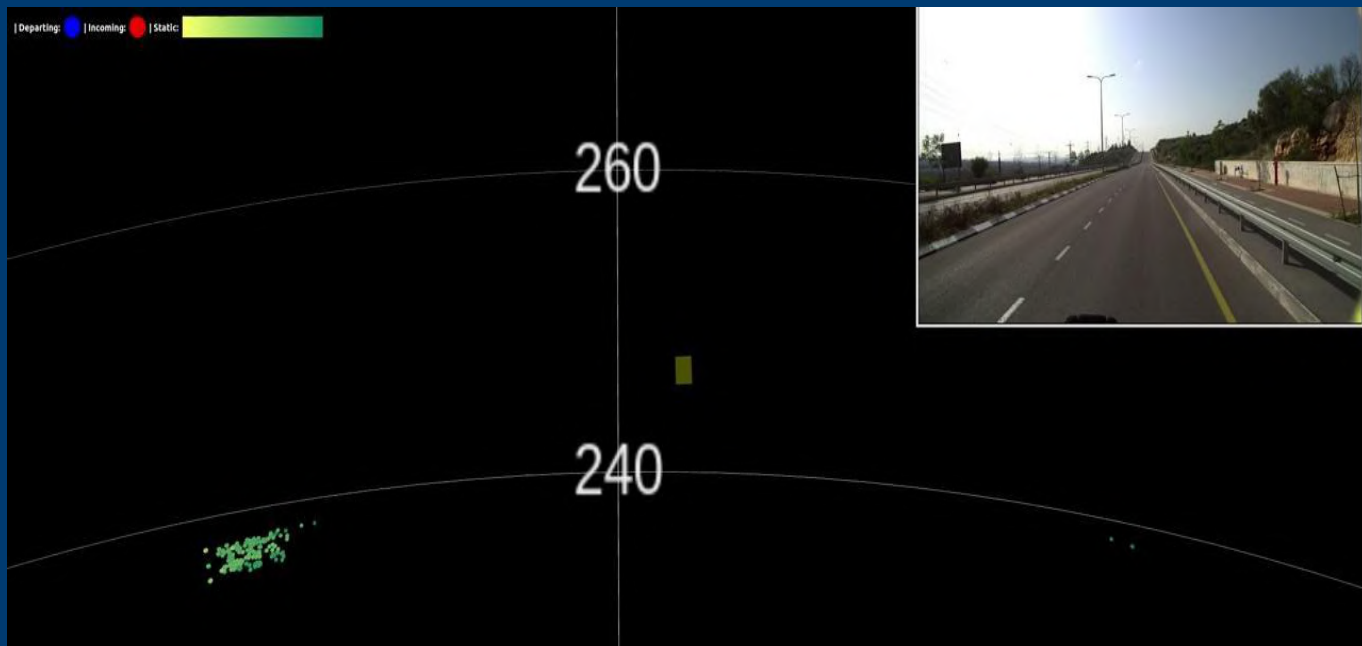
3D Detailed Environment



LOST CARGO - VALEO LIDAR SCALA 3 RESULTS



LOST CARGO - VALEO HD IMAGING RADAR RESULTS



THERMAL CAMERA PERFORMANCES IN POOR VISIBILITY CONDITIONS

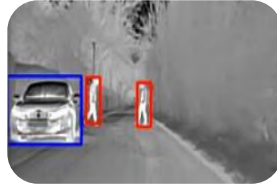
Valeo HDR
Camera

Valeo Thermal
Camera

*Urban
Night*



*Parked
Vehicle
in High
Beam*



Valeo HDR
Camera

Valeo Thermal
Camera

*Glare
with
Low
Beam*



Fog



**THERMAL CAMERAS EXTENDS VRU AND ANIMALS ODD
FOR L0-L2 DRIVER ASSISTANCE & L3/L4 AUTOMATED DRIVING**

CONCLUSION – A TEAM, NOT A COMPETITION

Automated **D**riving **S**ystems require **multiple sensing modalities**.

Lidar provides **critical 3D resolution** to classify static objects and solve the "Lost Cargo" (SOTIF) case.

HD Radar provides the **velocity and weather penetration** needed for dynamic "cut-in/cut-out" (SOTIF) cases and all-weather operation.

Thermal Camera provides **robust living object detection** (VRUs, animals) when other sensors are blinded by glare or darkness.

Together, they create a redundant and complementary system that can achieve the ASIL D safety and SOTIF acceptance criteria required for L3+ automation.

Safety is non-negotiable, human lives are at stake.

Valeo's combined HD Radar and Lidar unique system to support unsupervised (Level 3) Highway Pilot up to 130 kph without a lead vehicle.

THANK YOU !



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SMART TECHNOLOGY
FOR SMARTER MOBILITY