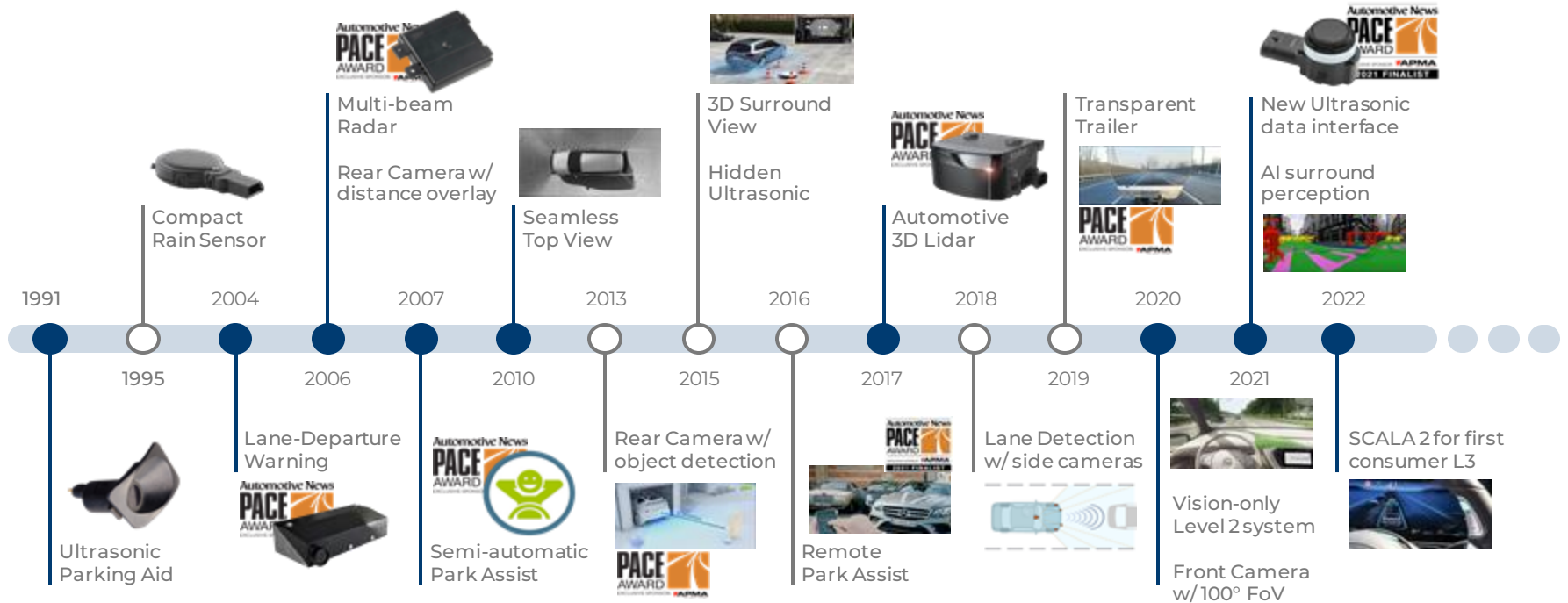




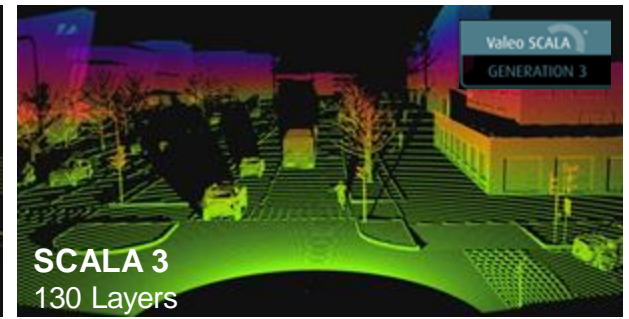
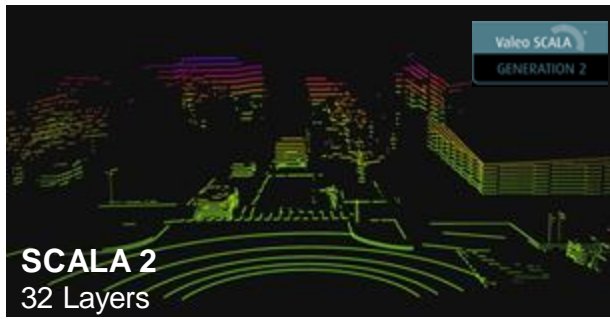
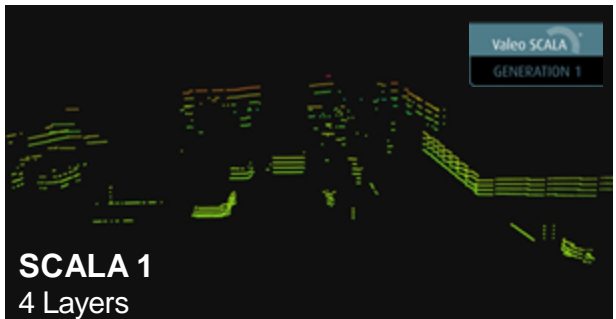
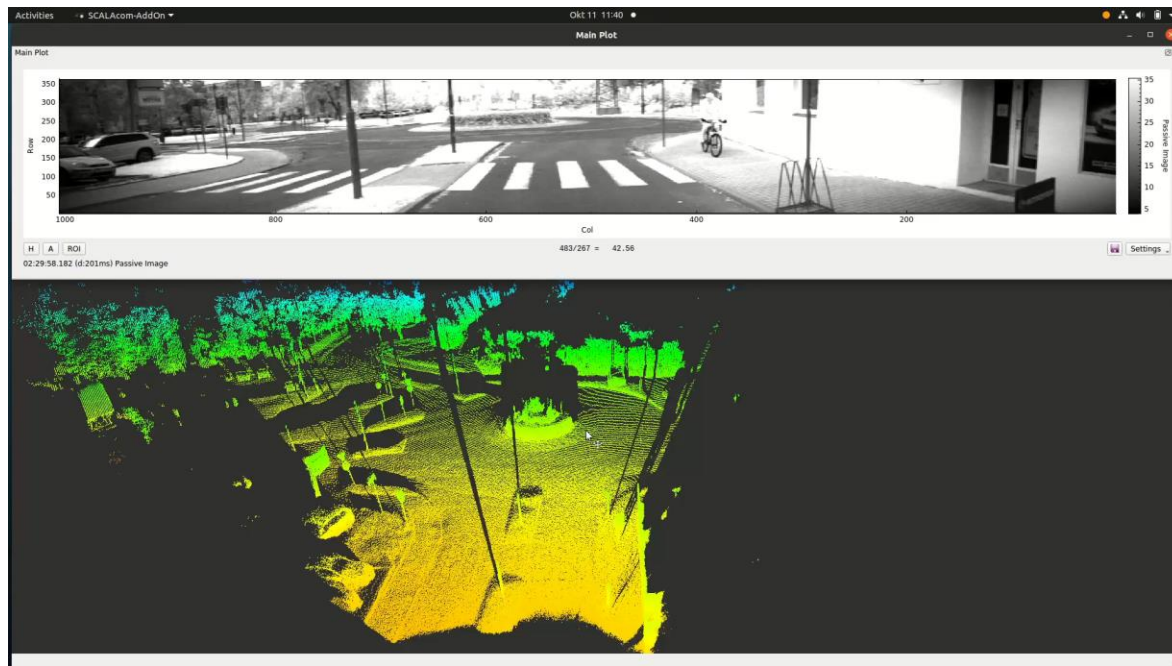
# **BIG** data and ADAS development

European Big Data Value Forum 2022

# A HISTORY OF INNOVATION



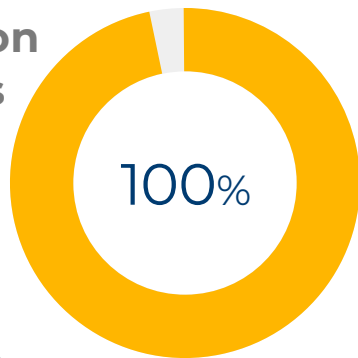
Added value through ADAS features to help offset the cost of the safety systems



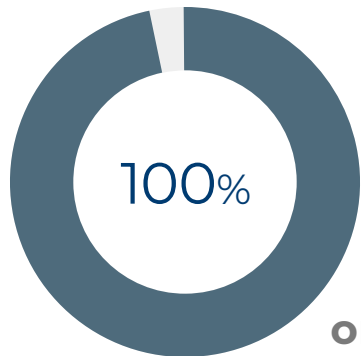
# ADAS MARKET in 10 YEARS

in mature markets

Active Safety on  
all new cars

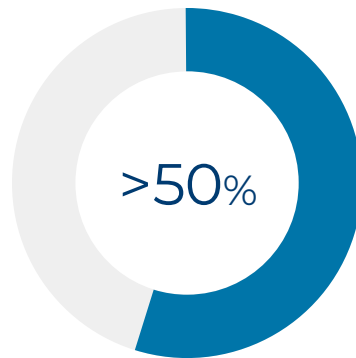


100%



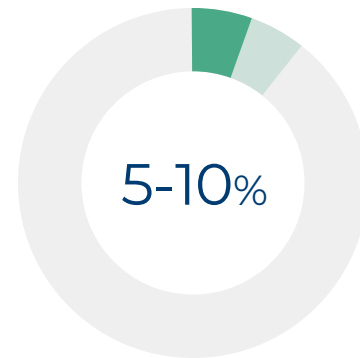
100%

Park Assistance  
on all new cars



>50%

L2/L2+ ADAS  
will be the rule

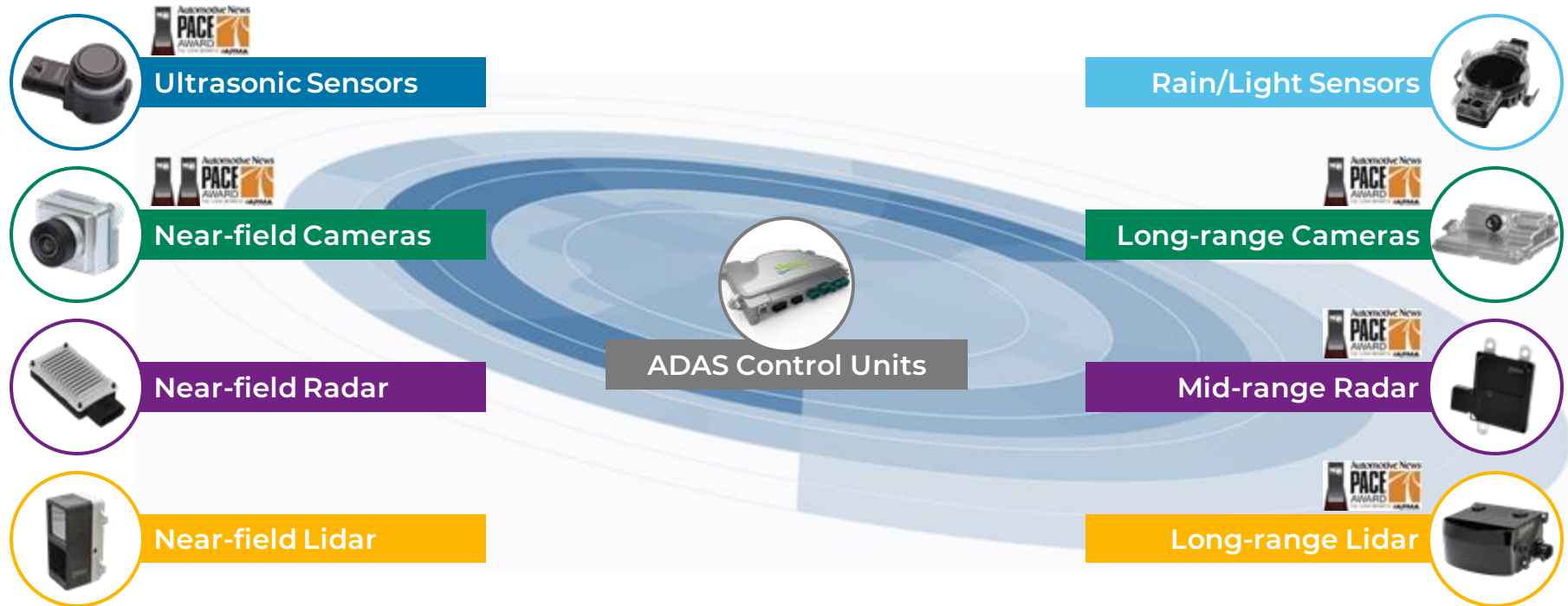


5-10%

L3/4 Driving on  
many models

Basic ADAS will be standard · L2+ to drive architecture and pave the way for L3/4 features

# Anatomy of ADAS and AD



**Triple redundancy is a must for L3+ -> Lidar**  
**~1 - 6GB/s of raw sensor data depending on configuration**

# Validating ADAS and AD is hard

ADAS/AD should not bring “unreasonable” risk to be accepted

Example: AEB system

- less than 1 false braking event in 1 Mkm
- Data collection 1.2 up to several Mkm, lots more in simulation
- ~ 70+ PB using loss-less compression
- For AD we might need **up-to 100x more**
- Unknown triggers and misuse should be covered - SOTIF ISO 21448

## Validating High-ASIL Systems via Testing Is Challenging

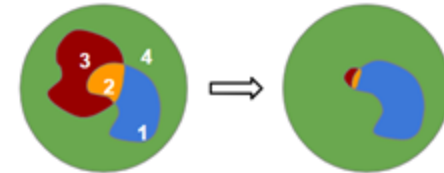
**Need to test for at least ~3x crash rate to validate safety**

- Hypothetical fleet deployment: New York Medallion Taxi Fleet
  - 13,437 vehicles, average 70,000 miles/yr = 941M miles/year
  - 7 critical crashes in 2015 [2014 NYC Taxi Fact Book]  
[Fatal and Critical Injury data / Local Law 31 of 2014]  
→ 134M miles/critical crash (death or serious injury)
- Assume testing representative; faults are random independent
  - $R(t) = e^{-\lambda t}$  is the probability of not seeing a crash during testing
- Illustrative: How much testing to ensure critical crash rate is at least as good as human drivers? → (At least 3x crash rate)
  - These are optimistic test lengths...
    - Assumes random independent arrivals
    - Is simulated driving accurate enough?

Testing Miles	Confidence if NO critical crash seen
122.8M	60%
308.5M	90%
<b>401.4M</b>	<b>95%</b>
617.1M	99%

Using chi-square test from: [http://reliabilityanalyticstoolkit.appspot.com/mtbf\\_test\\_calculator](http://reliabilityanalyticstoolkit.appspot.com/mtbf_test_calculator)  
SAE INTERNATIONAL Koopman & Wagner: 16 AE-0205 3

		Safe	Unsafe
Validation	Unknown	4	3
Verification	Known	1	2

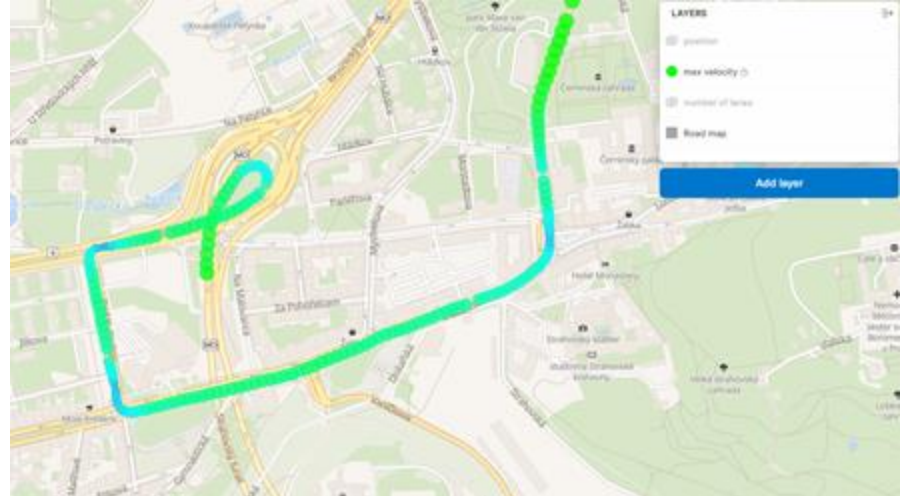


**Safety is our priority -> requirements for BIG data**



# ADAS/AD BIG DATA - unprecedented scale of data

- ➔ Multicriterial searchings across 10.000s hours of data (>1.000.000.000 frames), incl. metadata and signal time series patterns, identification of “similar situations”, high valuable data, driving scenarios, ...
- ➔ Continuously extending metadata classes by training and inference of AI/ML models.



**ADAS L3+ extreme IT infrastructure requirements - storage and compute**



# ADAS/AD BIG DATA - unprecedented scale of data

➔ Requirements for data ingest from multiple locations **world-wide**

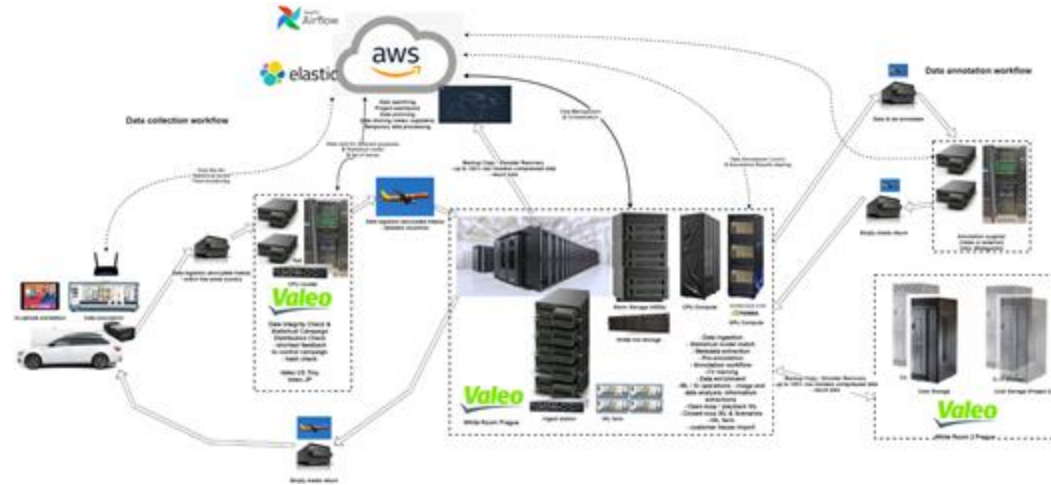
➔ Online vehicle tracking, remote diagnostics and data checks, OTA ingest at least for **sample data**



**ADAS L3+ extreme IT infrastructure requirements - data logistics & processing**

# ADAS/AD BIG DATA - unprecedented scale of data

- ➔ Data processing needs both in the cloud and local data centers. High bandwidths at the level of data recording. SiL with GPU emulation and usage of **custom HiL setups**.
- ➔ Needs for optimization to **reduce costs** - hot/cold storage fees vs local data center costs



**ADAS L3+ extreme IT infrastructure requirements - data logistics & processing**



SMART TECHNOLOGY  
FOR SMARTER MOBILITY