Velodyne LiDAR®

Driving Safety and Autonomy.™

Erich Smidt

Executive Director Europe

Light-DAR – Taking Sensor Integration to the Next Level

2005

2007

2005

2007

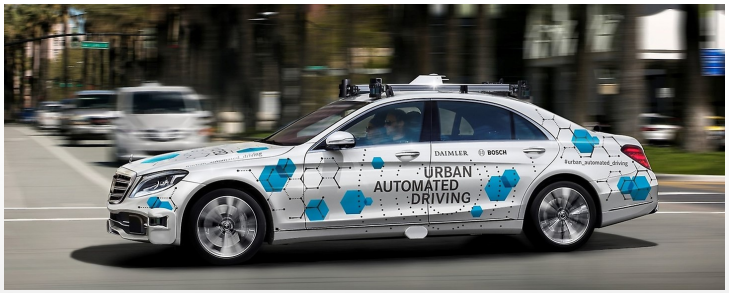
2007 - 2016

Today

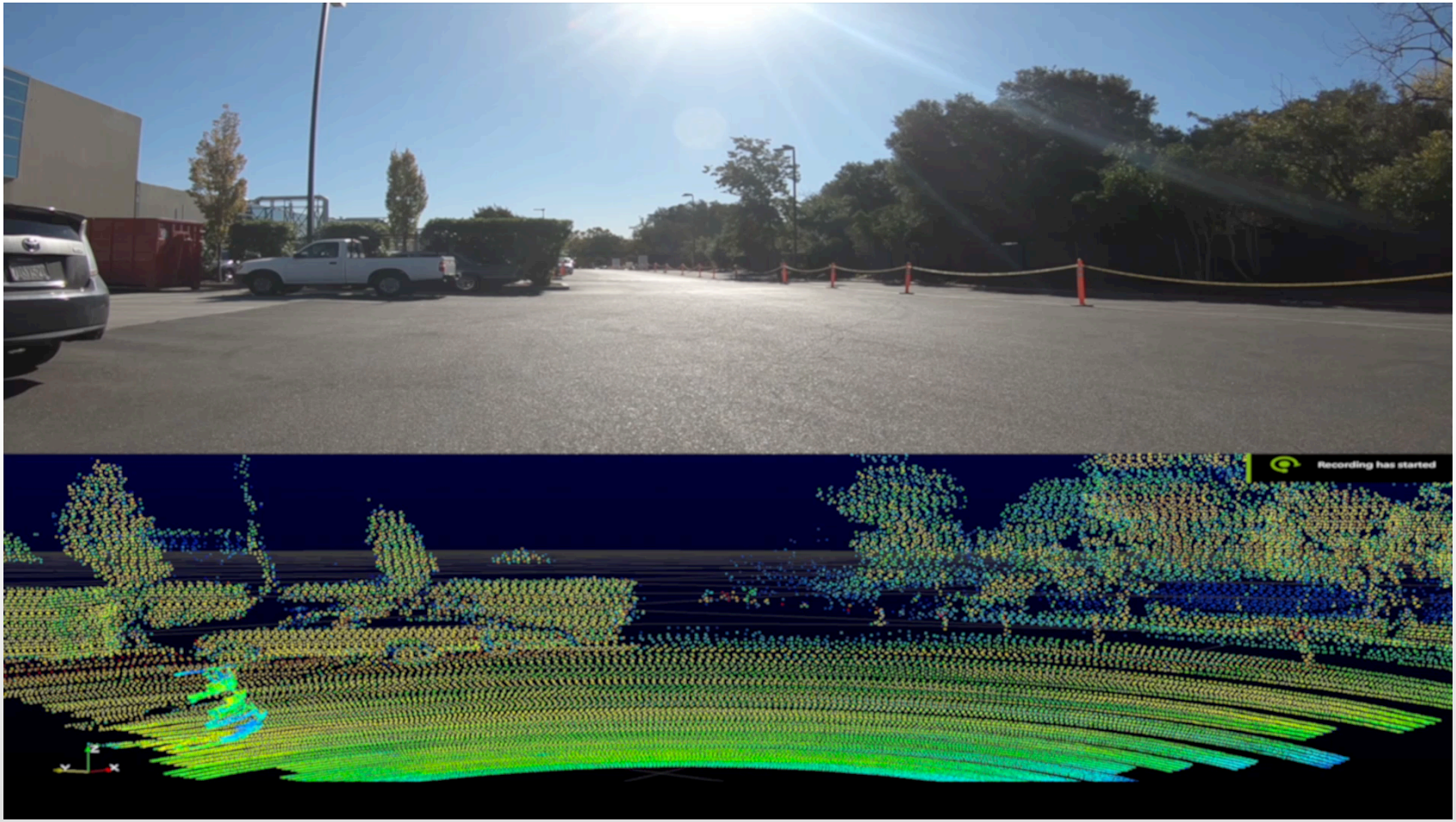
2005

2007

2007 - 2016



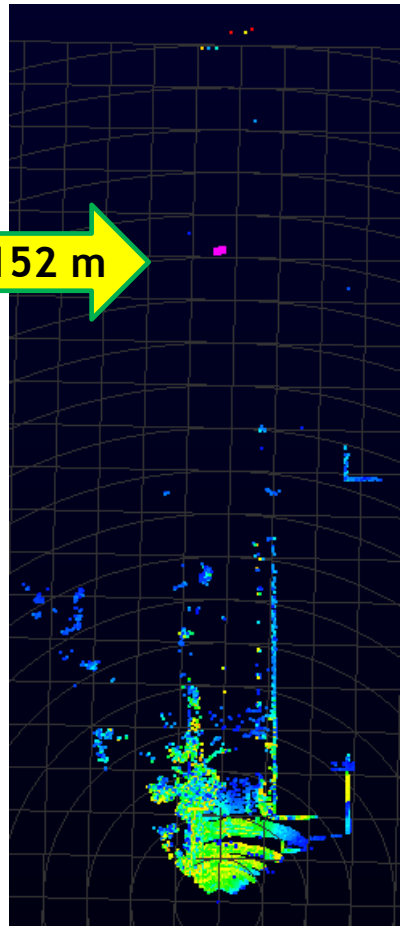
Today


Recording has started

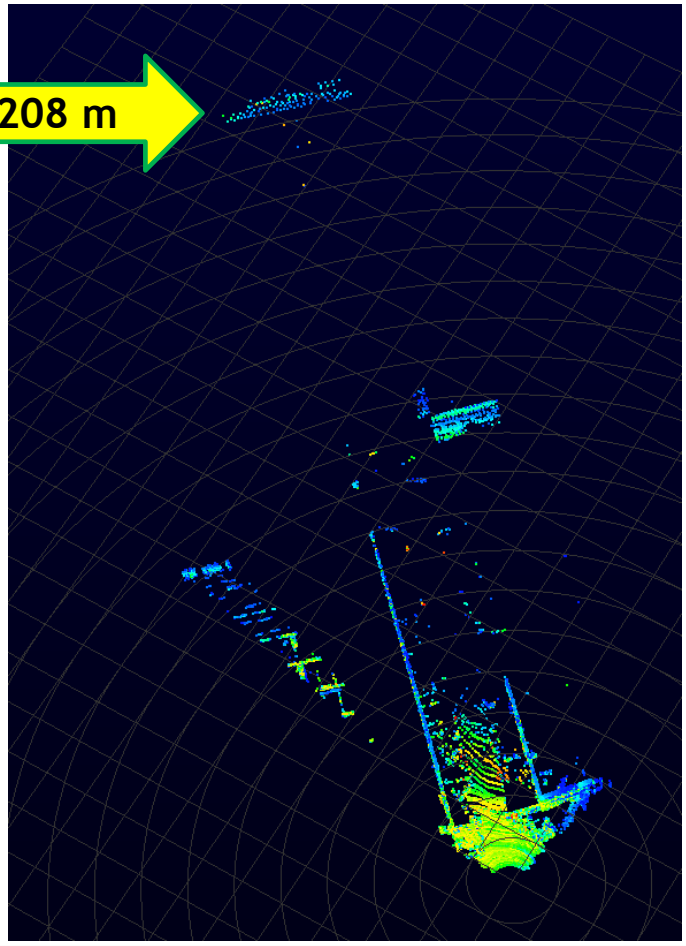
Velarray

Long Range

10% NIST target
1 x 1 m

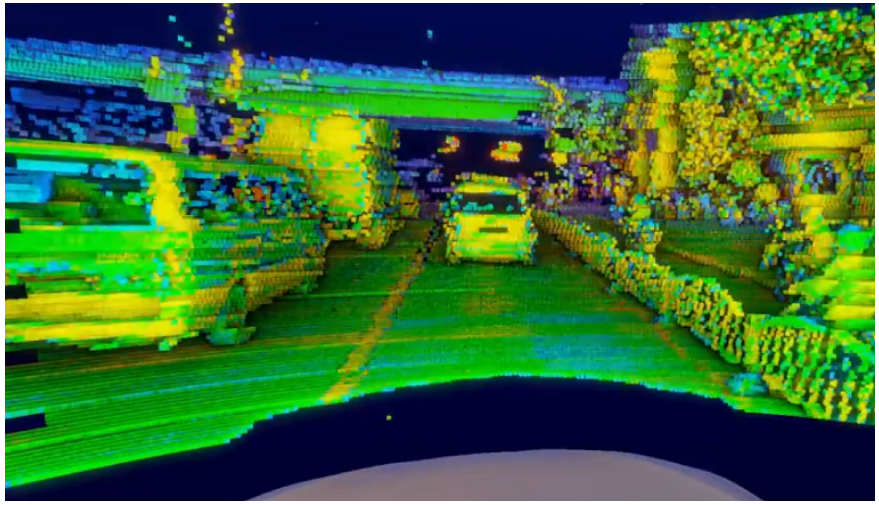


White Building
(60% Reflectance)
Sunny Day
No Clouds
Early Afternoon

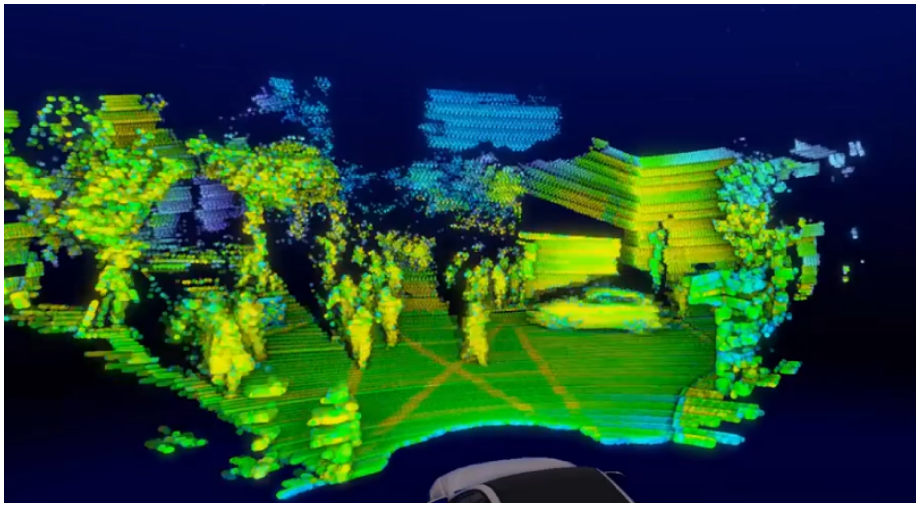


Velarray

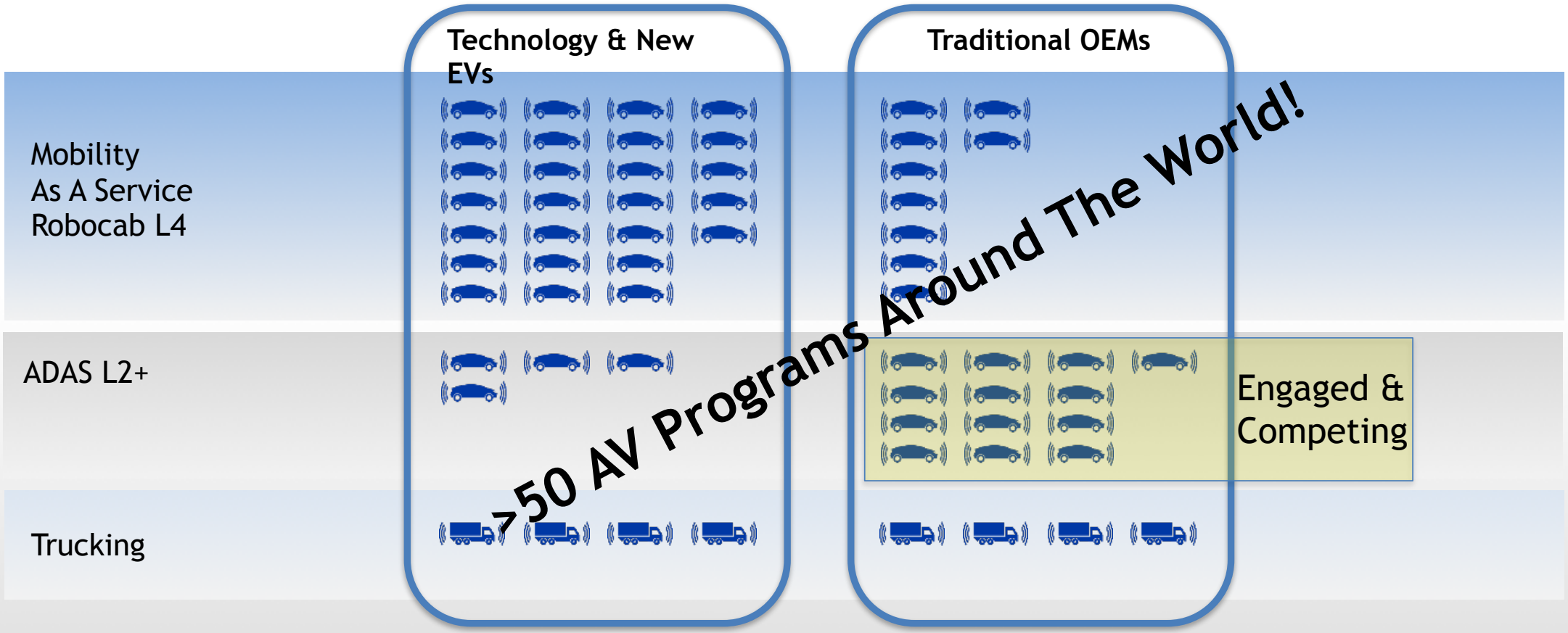
Visibility of road markers



Lane Markers



Cross-walks


Technology & New EVs
Traditional OEMs
Mobility As A Service Robocab L4
ADAS L2+
Trucking
>50 AV Programs Around The World!
Engaged & Competing

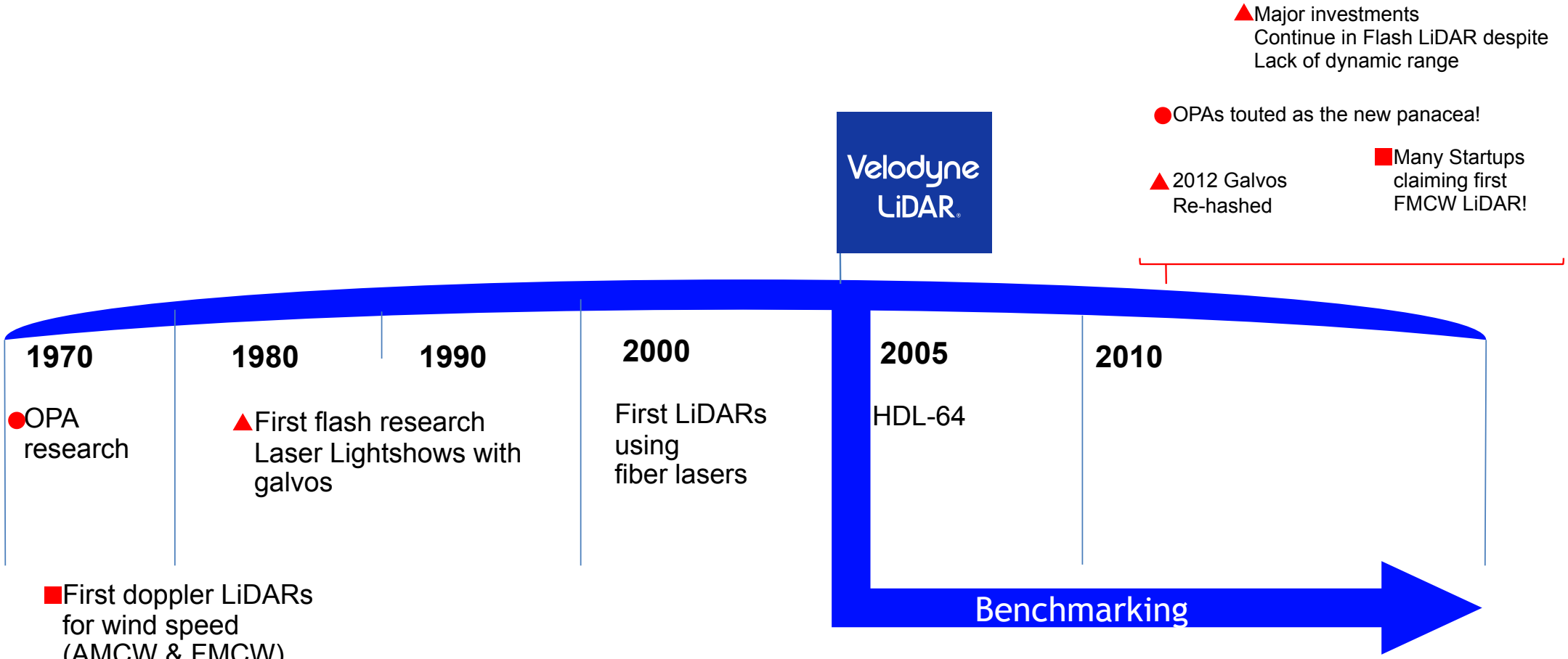
Agenda

LIDAR Technology

“Bringing Light into the dark”

What is needed?

Integration Challenges


Major investments
Continue in Flash LiDAR despite
Lack of dynamic range
OPAs touted as the new panacea!
Many Startups
claiming first
FMCW LiDAR!
2012 Galvos
Re-hashed
Velodyne
LiDAR
1970
1980
1990
2000
2005
2010
OPA
research
First flash research
Laser Lightshows with
galvos
First LiDARs
using
fiber lasers
HDL-64
First doppler LiDARs
for wind speed
(AMCW & FMCW)
Benchmarking

And Then There Were More….Many More!

Physics cannot be changed

Frame-rate

Range

Field of View

Costs

Resolution

Accuracy

Power Consumption

Temperature & Heat Load

Form Factor

Bringing Light into the Dark

Flash LiDAR

Camera+LiDAR

Scanners

Structured Light

MEMS

OPA

LiDAR+Camera

- Ask what the LIDAR needs to contribute to the perception system?
- Standardization of validation and t

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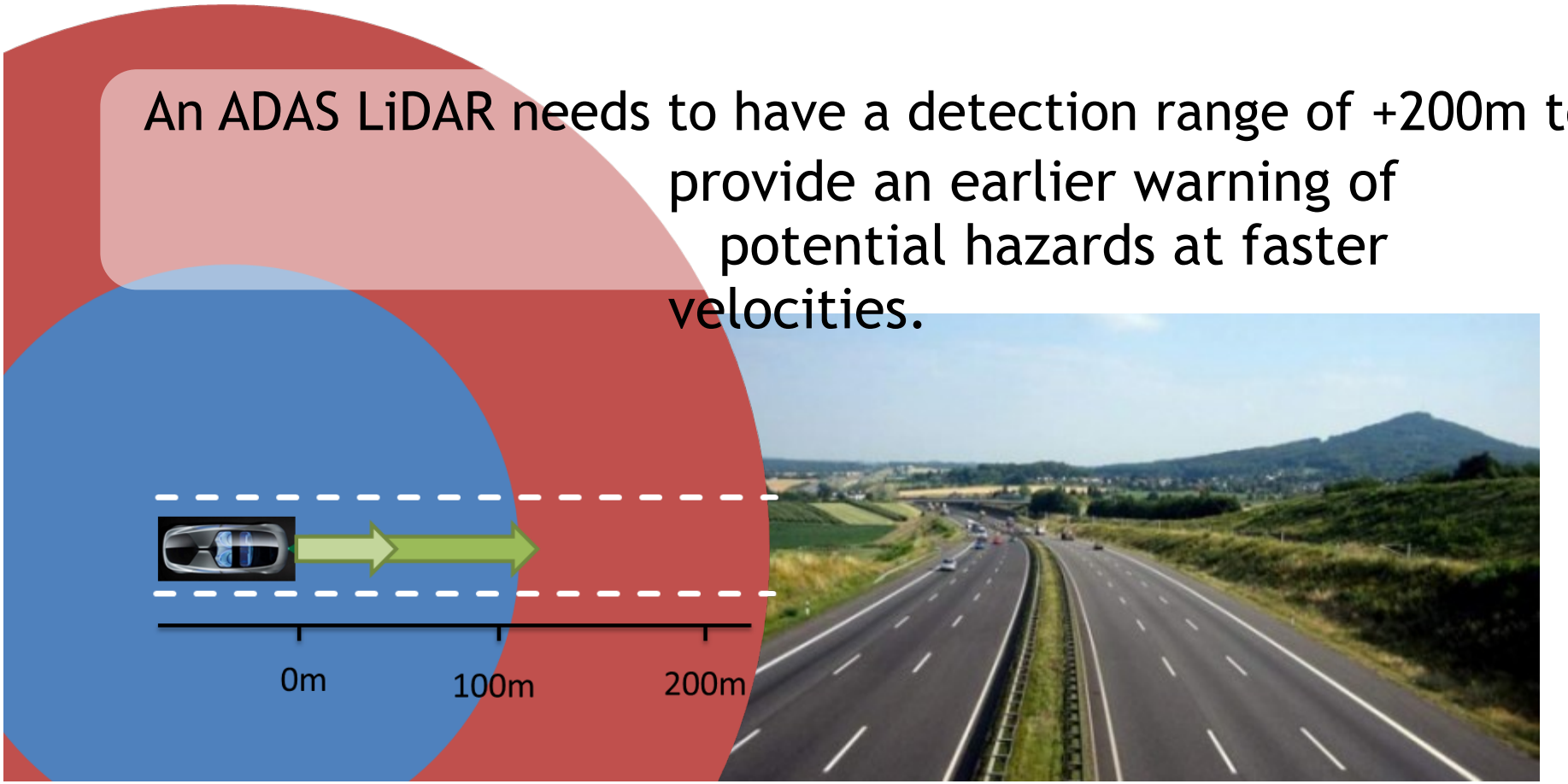
Capabilities of an ADAS LiDAR

Range

An ADAS LiDAR needs to have a detection range of +200m to provide an earlier warning of potential hazards at faster velocities.



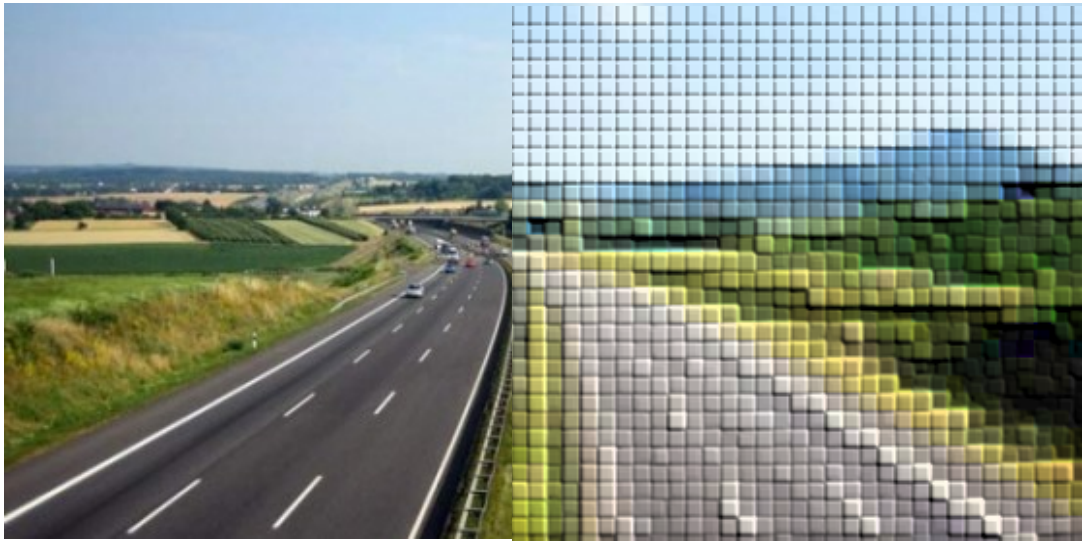
Capabilities of an ADAS LiDAR

Range

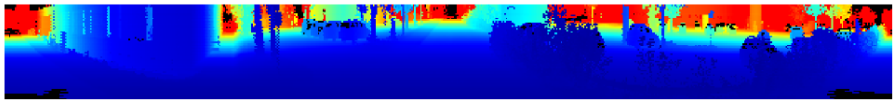
Resolution

An ADAS LiDAR needs to have high resolution.

- Multiple points for object detection and tracking
- A lot of points for object identification and classification

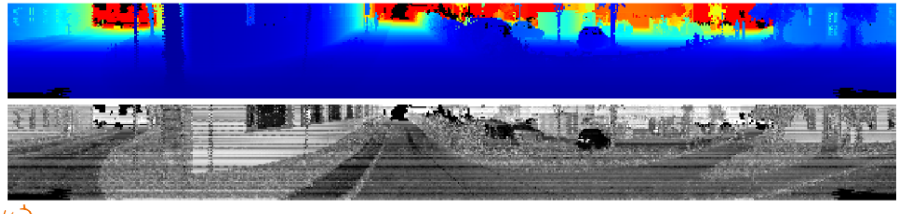


scene no. 1: depth image (360° surround view, 64 lines → 64 x 2100 „pixel“)



and the same scene as intensity „image“

scene no. 3:depth and intensity image



Source: Professor Joe Wuensch

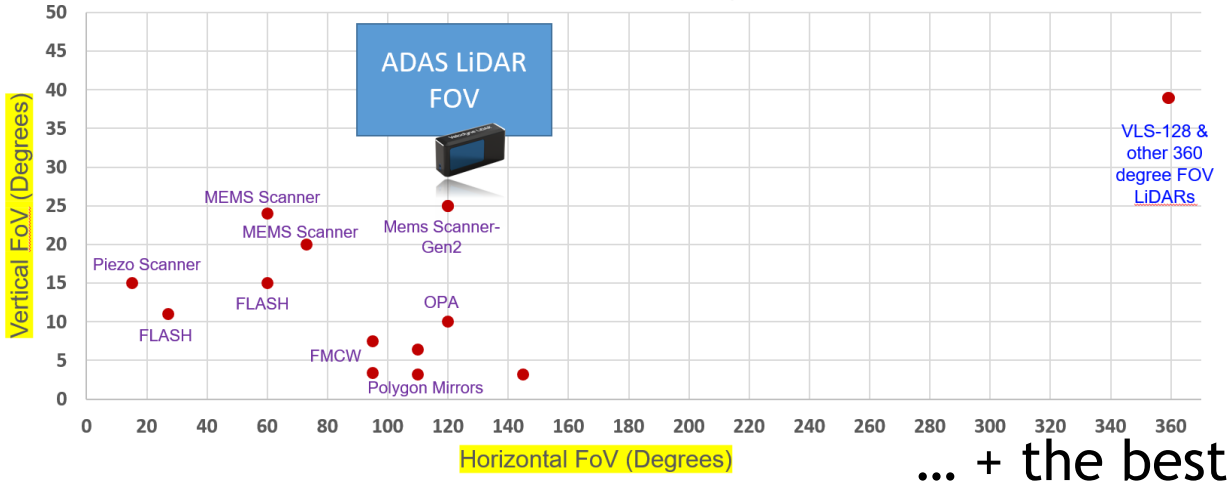
Capabilities of an ADAS LiDAR

Range

Resolution

Field of View

An ADAS LiDAR needs a large field of view…



… + the best placement in the car.

Capabilities of an ADAS LiDAR

An ADAS LiDAR needs to have a small form factor to be easily and seamlessly integrated into a vehicle.

- Rear view mirror
- Grill
- Bumper
- Sideview mirrors
- Roof
- B-Pillar
- **Headlamps**

Capabilities of an ADAS LiDAR

Range

Resolution

Field of View

Form Factor

Agenda

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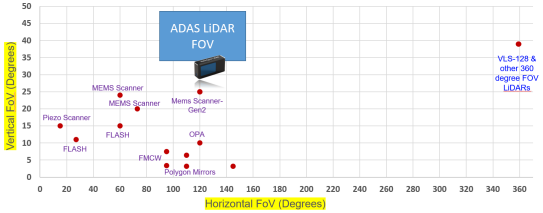
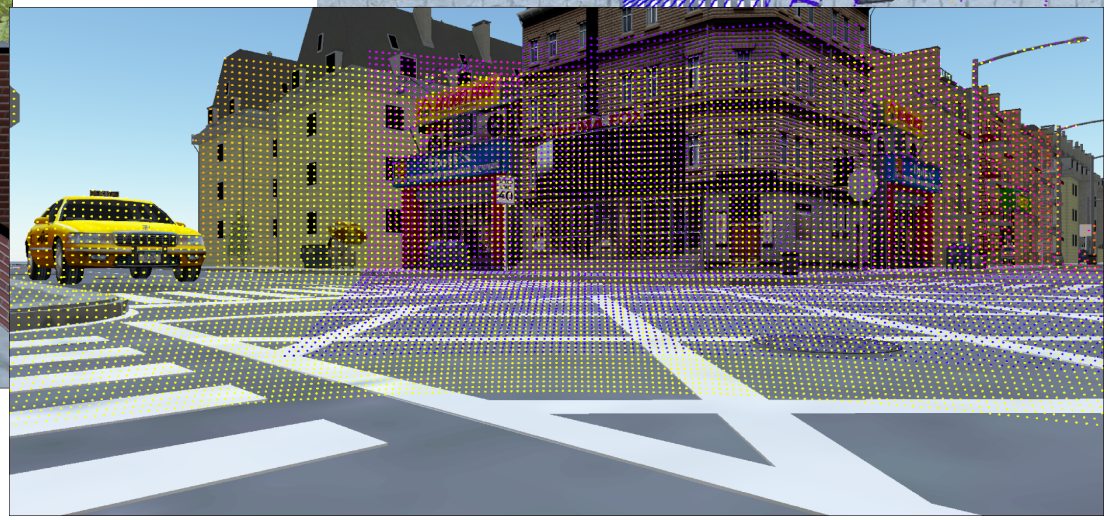
What is needed?

Integration Challenges

Capabilities of an ADAS LiDAR

Large field of view…. + the best placement in the car.





dSPACE

Capabilities of an ADAS LiDAR

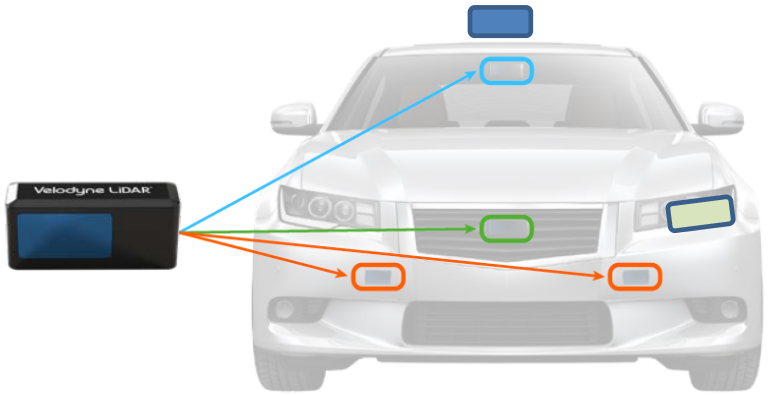
Benefits of headlamp integration:
- Great position for several ADAS use cases and AD cases (T-Junction)
- Cleaning by headlamp cleaner
- Reduced exposure to projectiles/contamination
- Enhanced lighting features like ROI, warning, HMI

Challenges and working areas for headlamp integration
- Partnership with Headlamp suppliers is key
- Mechanical Integration & Packaging Concepts
- Heating & Cooling Concepts
- Cover Materials
- Interference investigation – LED + Halogen Light sources

Velodyne LiDAR

Topics adressed together with Tier 1 partners & OEMs

Examples of how Velarray could be embedded in a vehicle



Option #1: Single sensor windshield moun
Option #2: Single sensor high mounting
Option #3: Two sensors near head lamps
Option #4: Multiple sensors on the roof
Option #5: Headlamp Integration

Velodyne at CES