

ROLE OF LAMPS FOR UPCOMING AUTONOMOUS VEHICLES

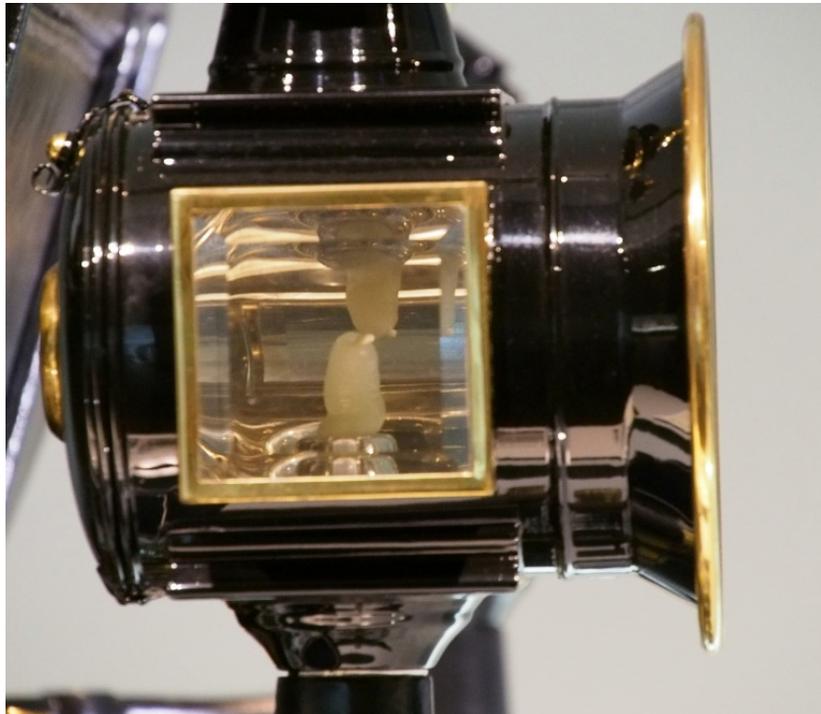
M. Sasaki Koito Manufacturing co., Ltd.

DVN Shanghai International Workshop April 24 2019

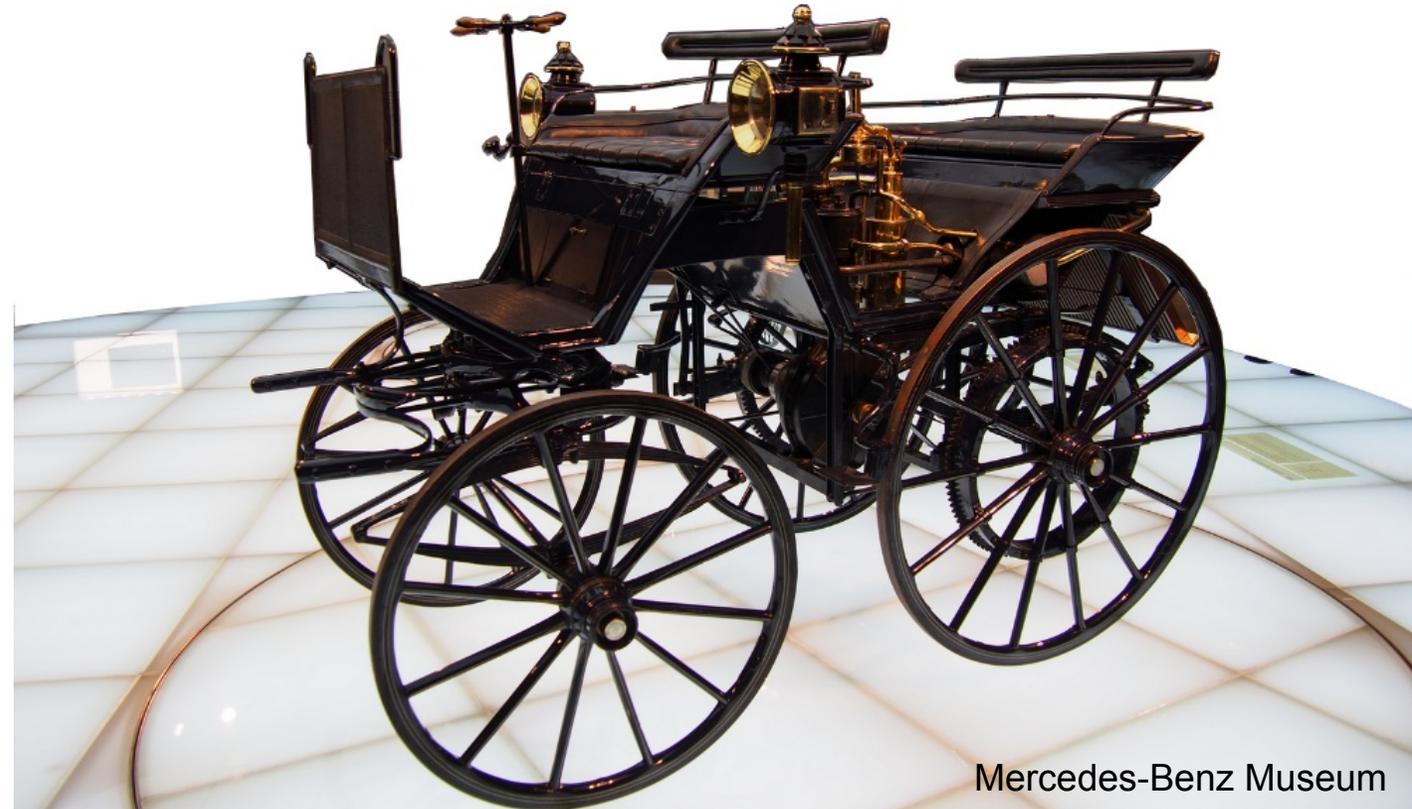
0. Lighting and Signaling

- ◆ Lighting and light signaling are essential driver assistants

One candle power



Daimler Motorized Carriage 1886

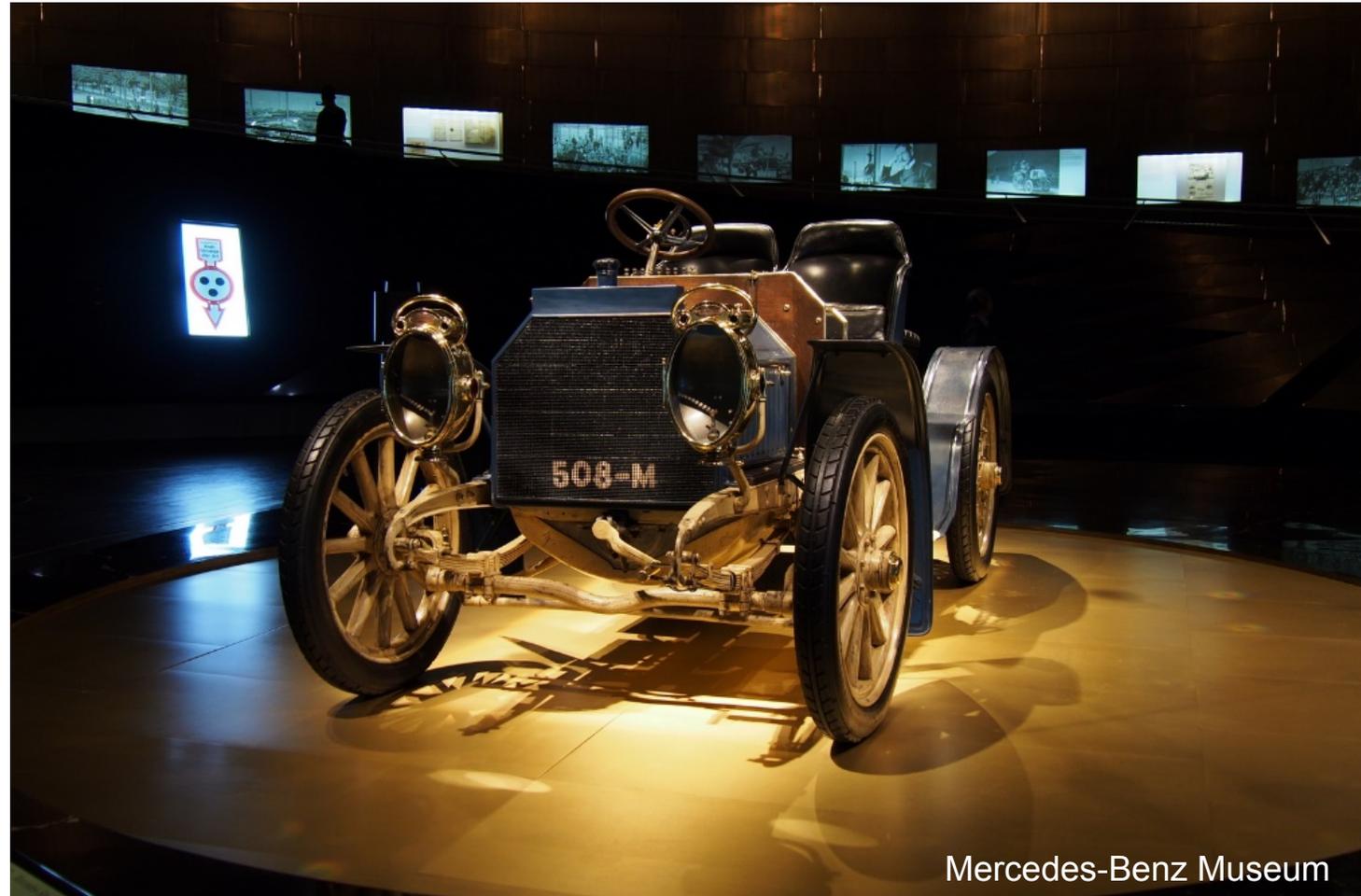
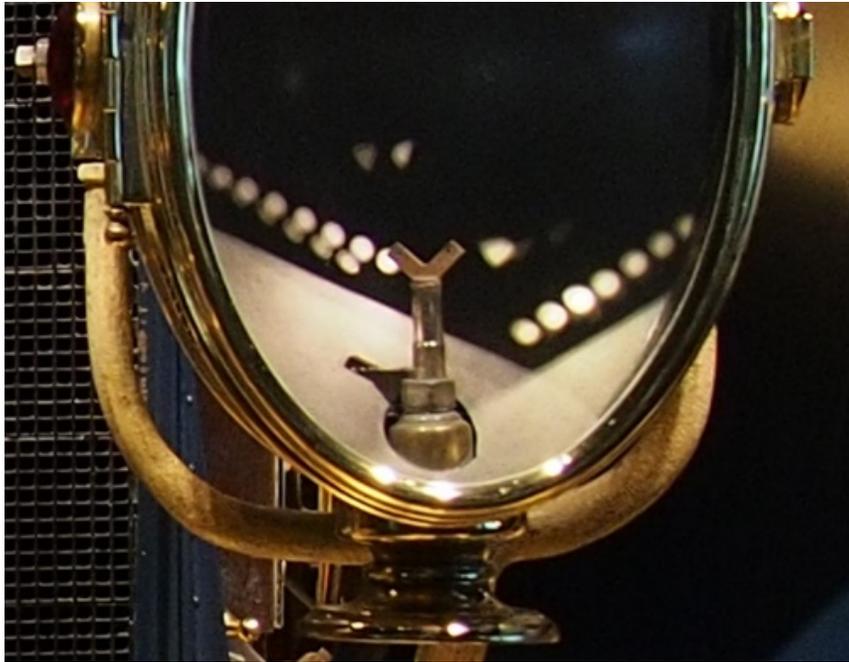


Mercedes-Benz Museum

0. Lighting and Signaling

- ◆ Lighting and light signaling are essential driver assistants

Acetylene torch



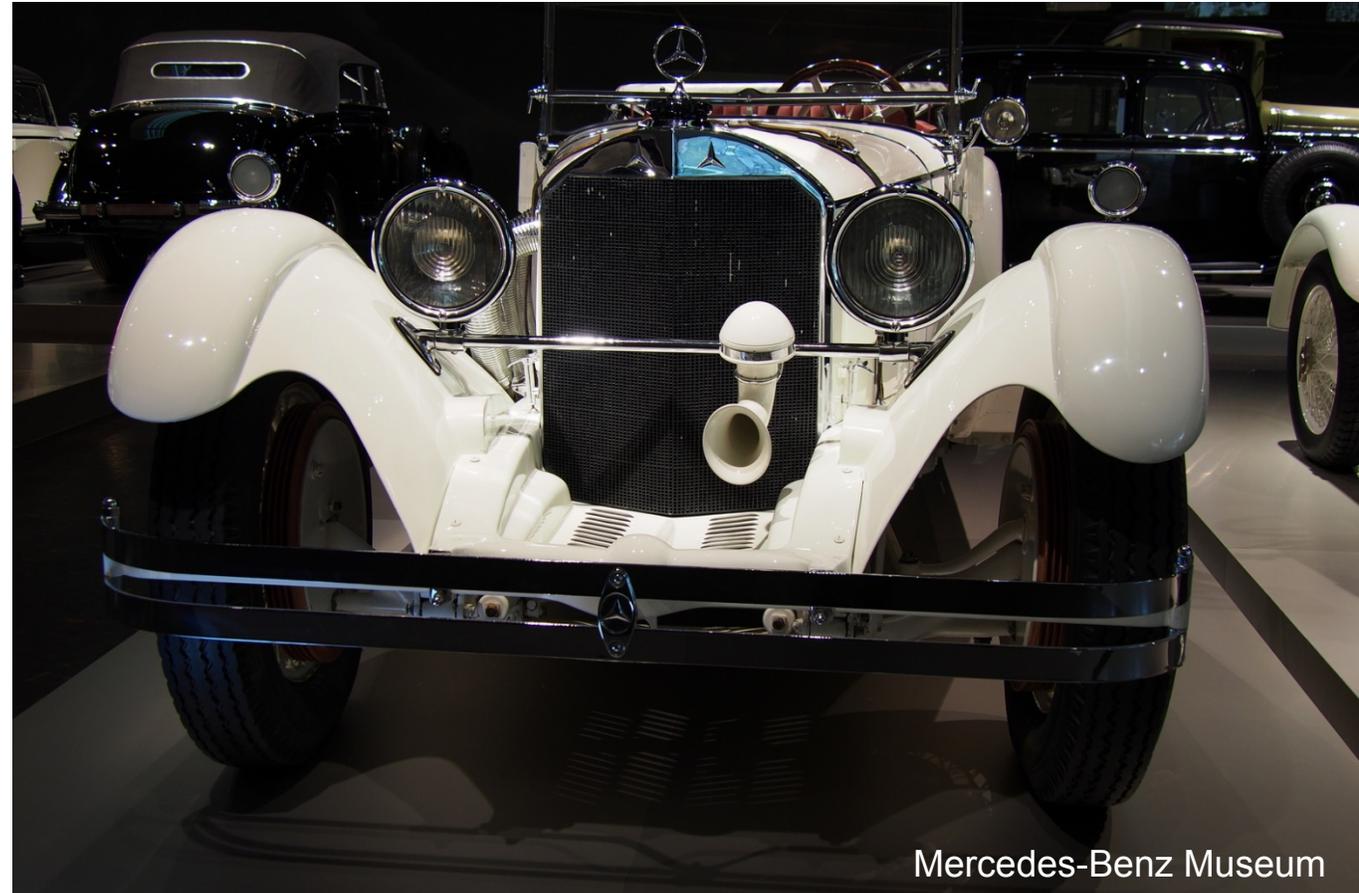
Mercedes-Benz Museum

0. Lighting and Signaling

- ◆ Lighting and light signaling are essential driver assistants

Mercedes-Benz model S 1928

Electricity



Mercedes-Benz Museum

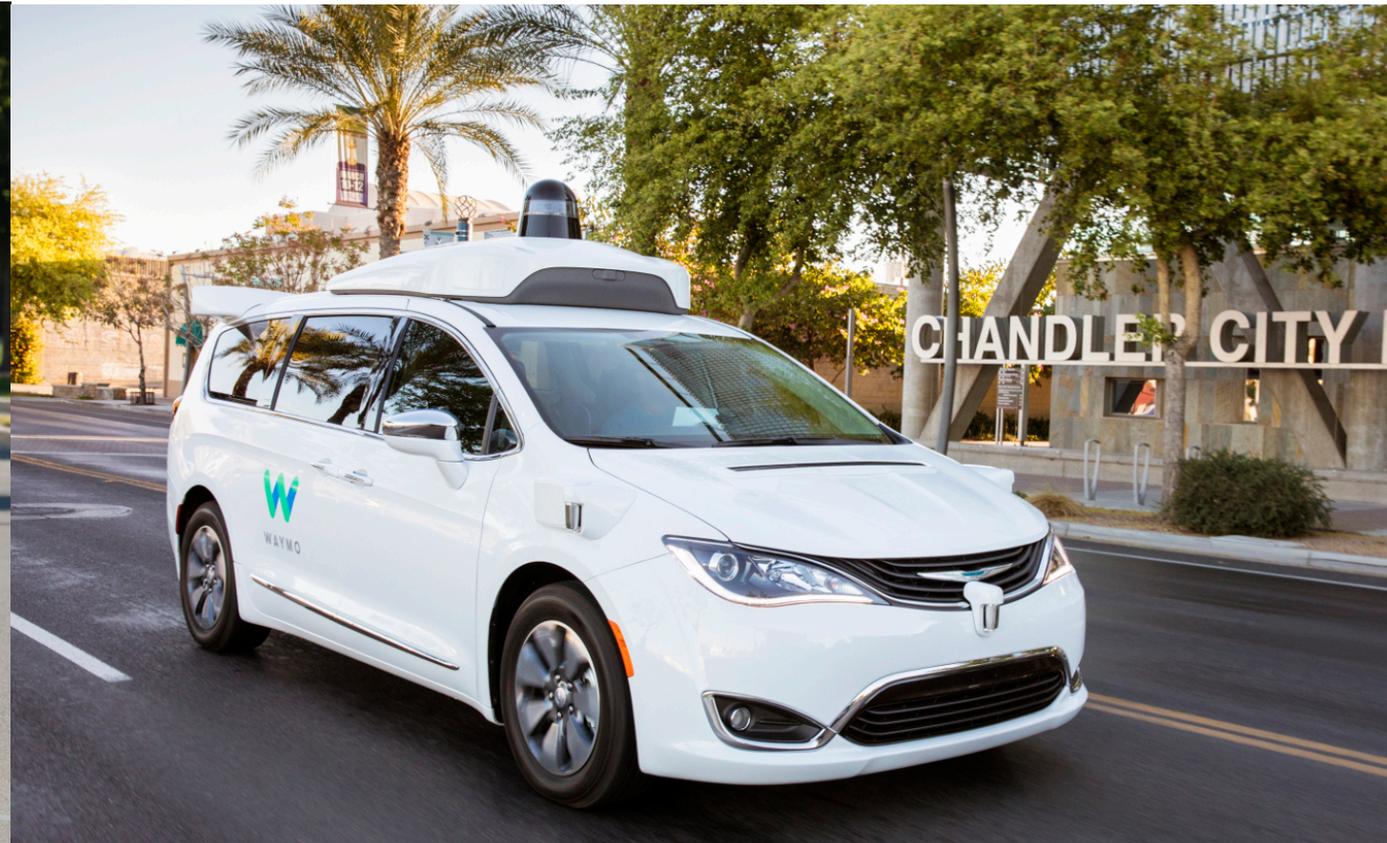
1. Era of Self-Driving Vehicles

- ◆ Autonomous Vehicles are coming to real world

Self-driving cars from Waymo

Photo: <https://waymo.com/press/>

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1. Era of Self-Driving Vehicles

- ◆ Autonomous Vehicles are coming to real world

CES Asia 2018

Aplong

Self-driving bus
from Baidu



1. Era of Self-Driving Vehicles

- ◆ Autonomous Vehicles are coming to real world

ePallet, Self-driving multi-purpose vehicle from Toyota

CES 2018



- ◆ Introduction started in two stories

1. For commercial and services

- Level 4, 5 coming very soon with restrictions (limited area and/or speed)
 - already started in specific areas

2. For personal cars

- Level 4, 5 coming but slower than commercial vehicles
- Level 2, 3 with progress of ADAS functions
 - fun to drive with safety

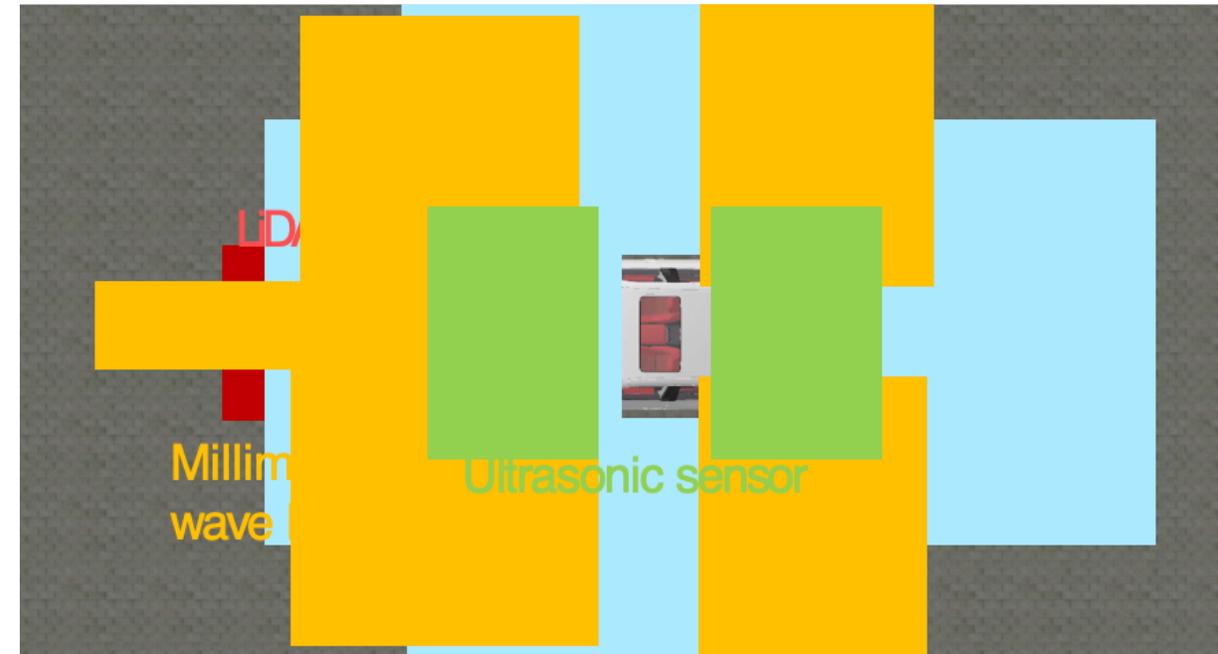
- ◆ What can we do with lamps?

- ◆ Lamps will contribute for
 - Help sensors - install, manage and keep clean
--> §2. Lamps for Sensor Integration
 - Artificial communication instead of human drivers
--> §3. Lamps for Communication
 - Lighting as ADAS
--> §4. Progress on Personal Cars

2. Lamps for Sensor Integration

- ◆ Many sensors to be installed

Photo: <https://waymo.com/press/>



2. Lamps for Sensor Integration

- ◆ Front / Rear lamps will integrate sensors

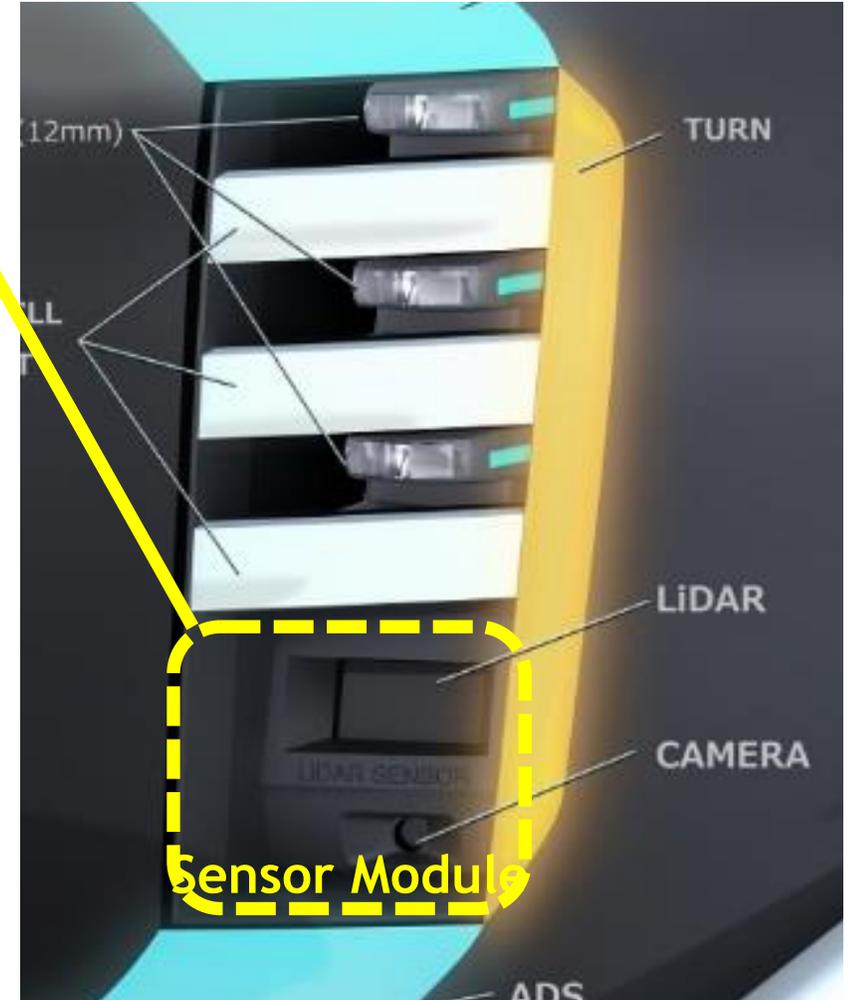
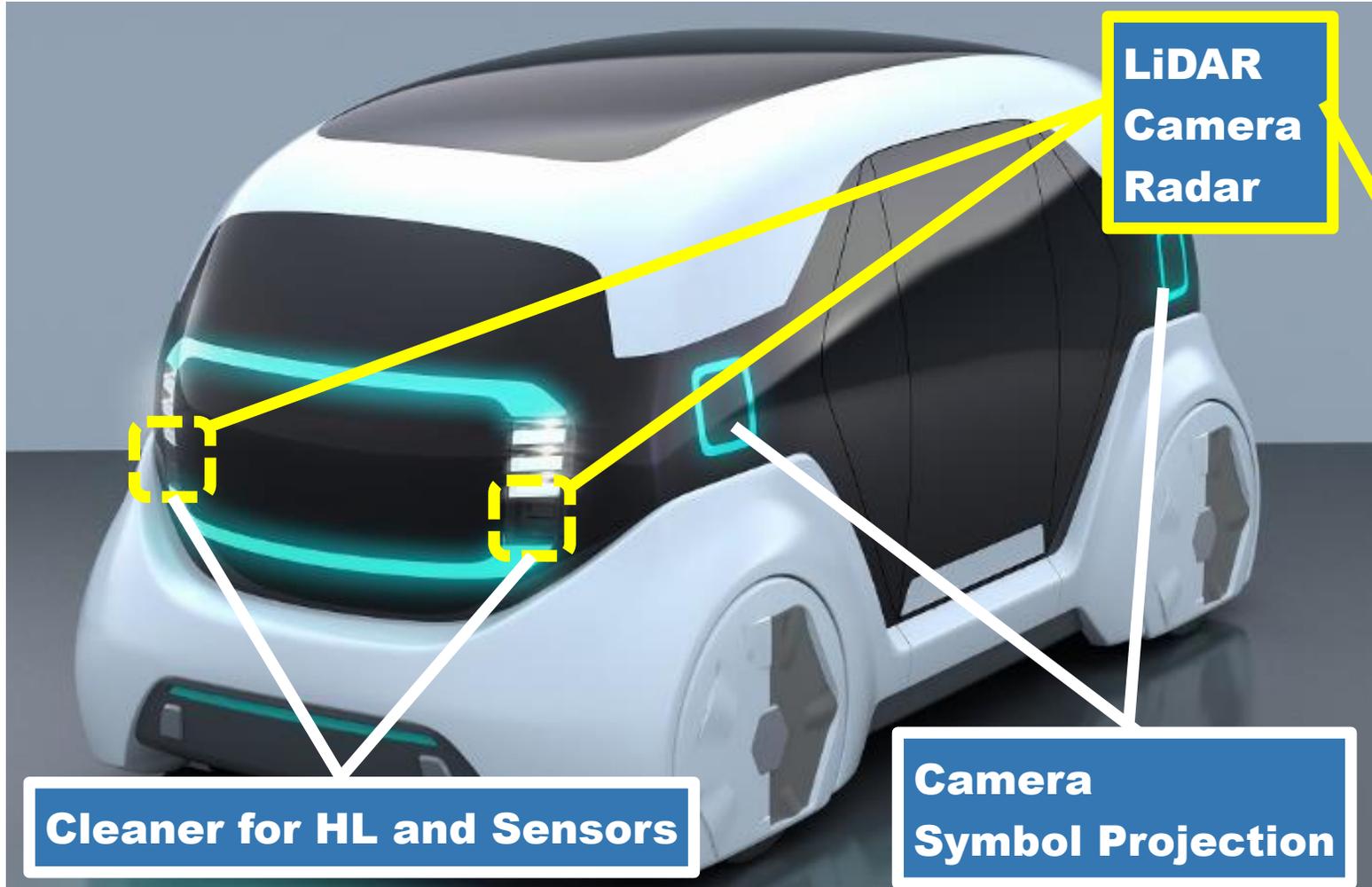
Koito Concept, CES 2018



2. Lamps for Sensor Integration

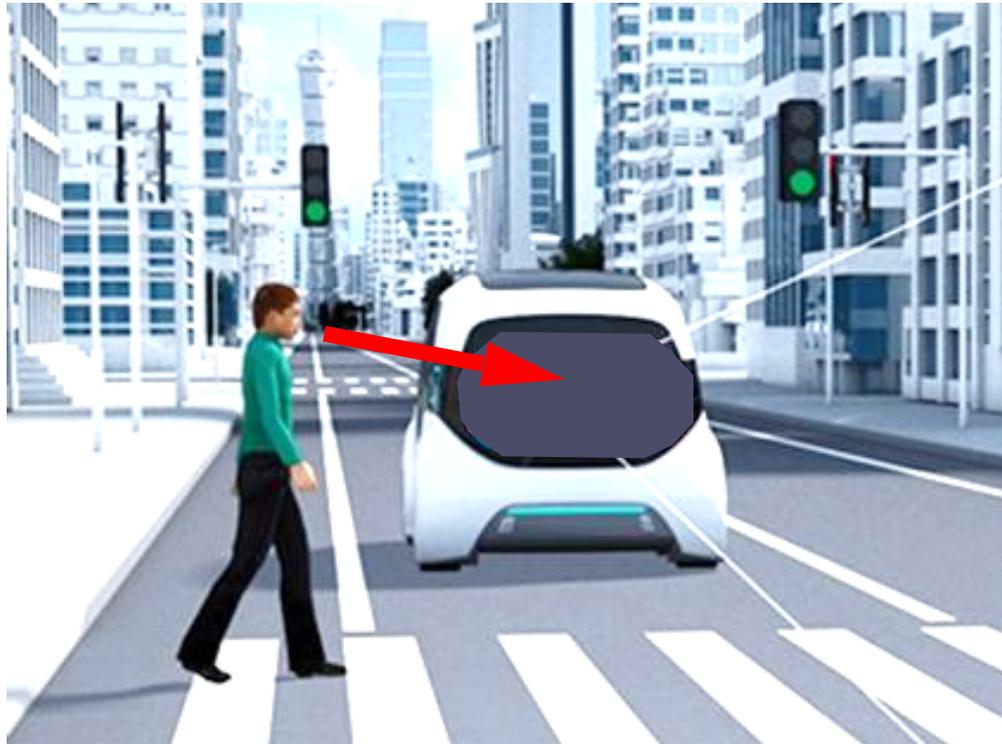
- ◆ Lamps to watch and recognize surroundings

Koito Concept, CES 2019



3. Lamps for Communication

- ◆ ‘Eye contact’ and ‘Gesture’ are often used while driving city
- ◆ No drivers (level 5) or no duty to watch (level 3,4)

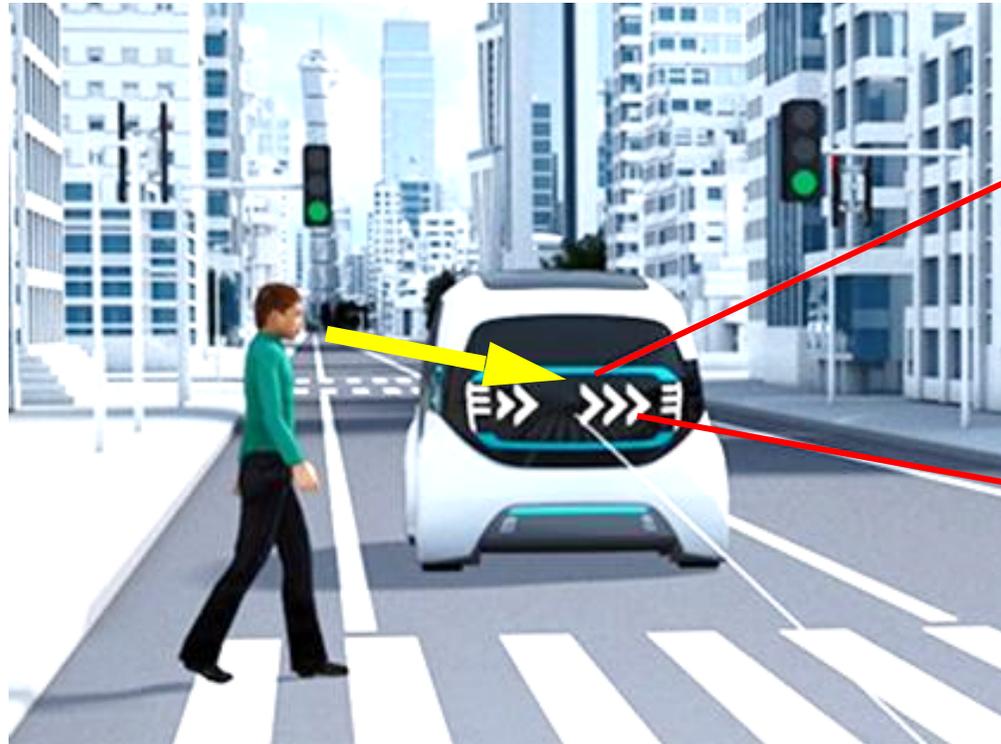


- What is next motion of the car?
- Does it wait for me?

How are driverless vehicles accepted in society?

3. Lamps for Communication

- ◆ Driverless vehicles need artificial communication



AV Marker / Signal

Graphical / Animation Display

3. Lamps for Communication

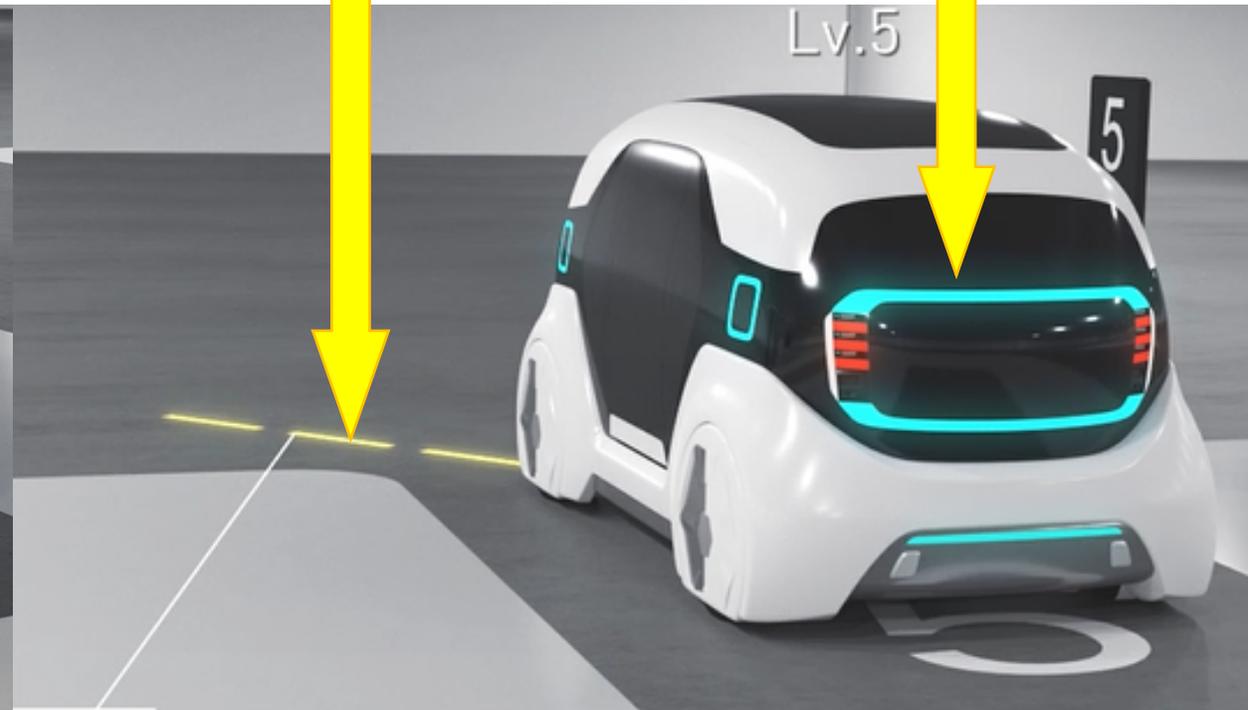
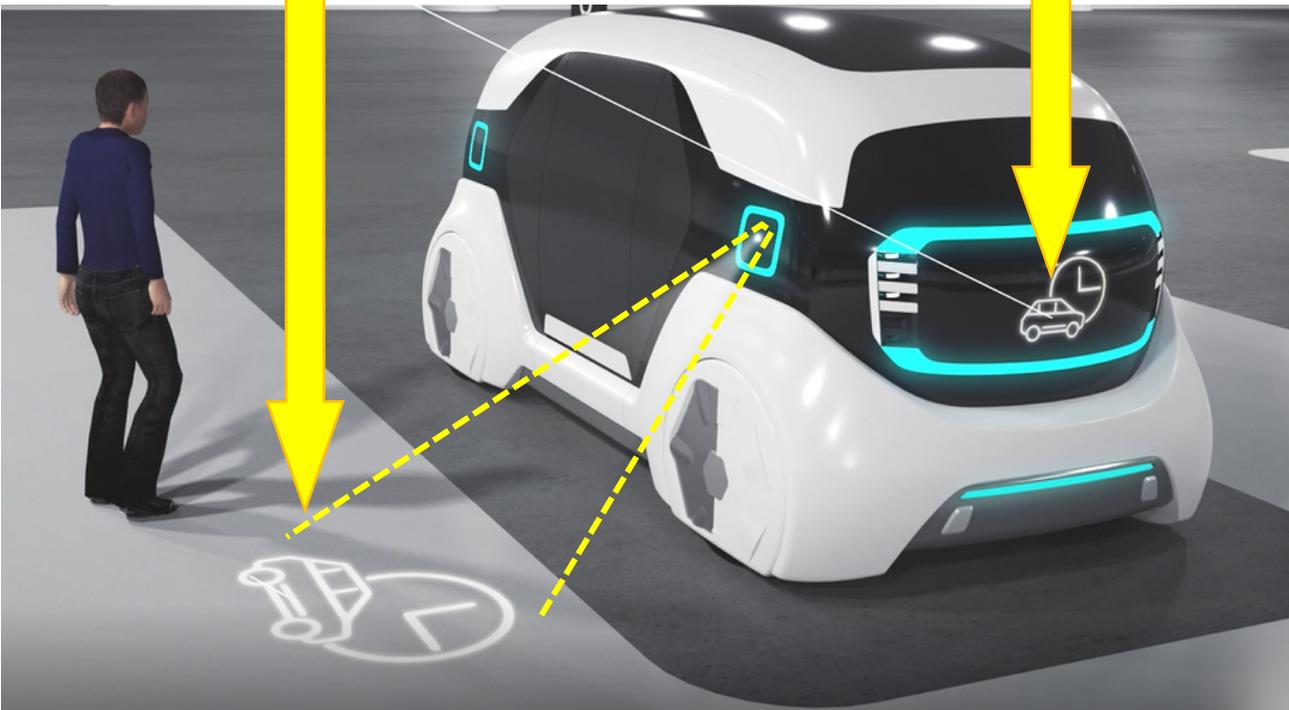
- ◆ Communication using lamps and projections

Graphical / Animation Display

AV Marker / Signal

Projection

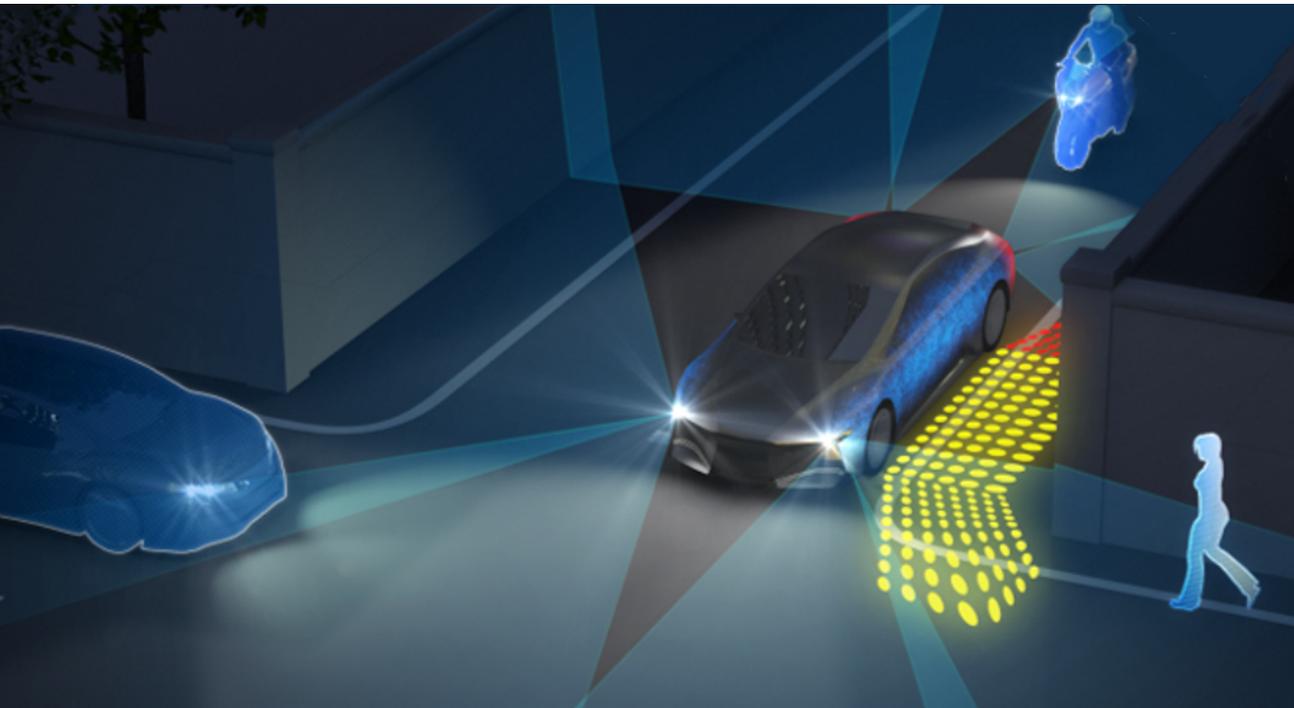
Projection



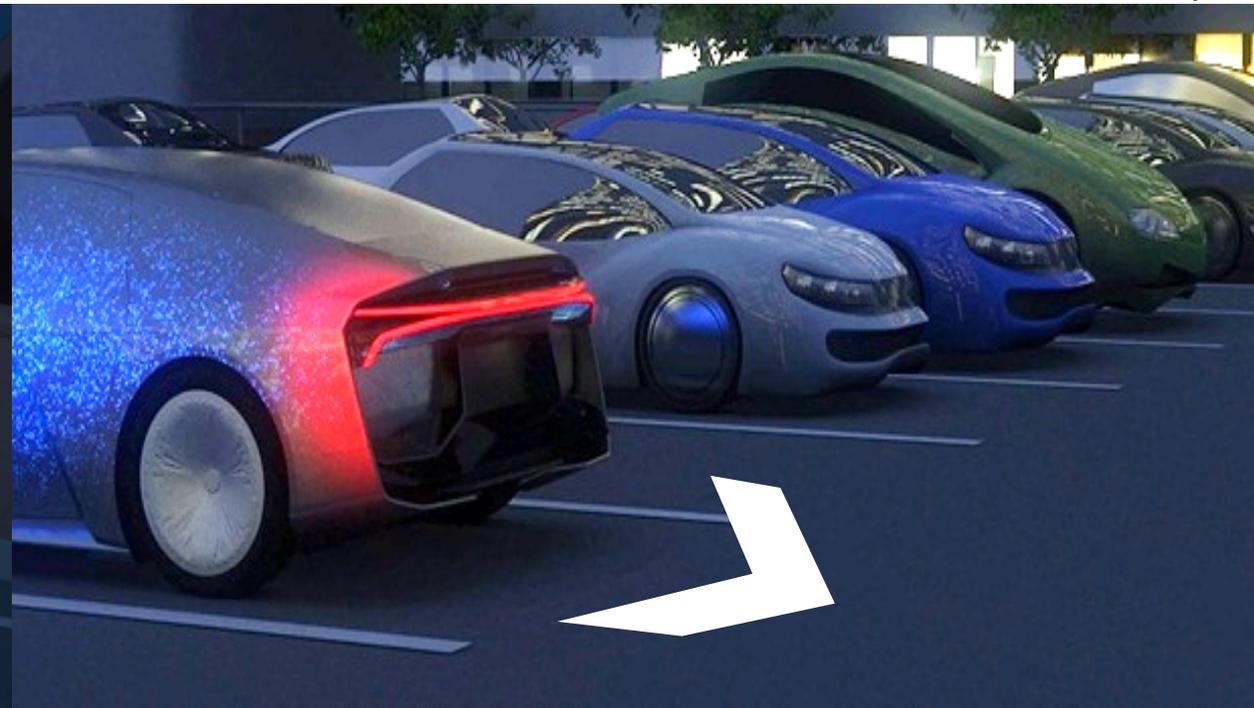
3. Lamps for Communication

- ◆ Projections are helpful to human-driven vehicles also

Projected direction indicator

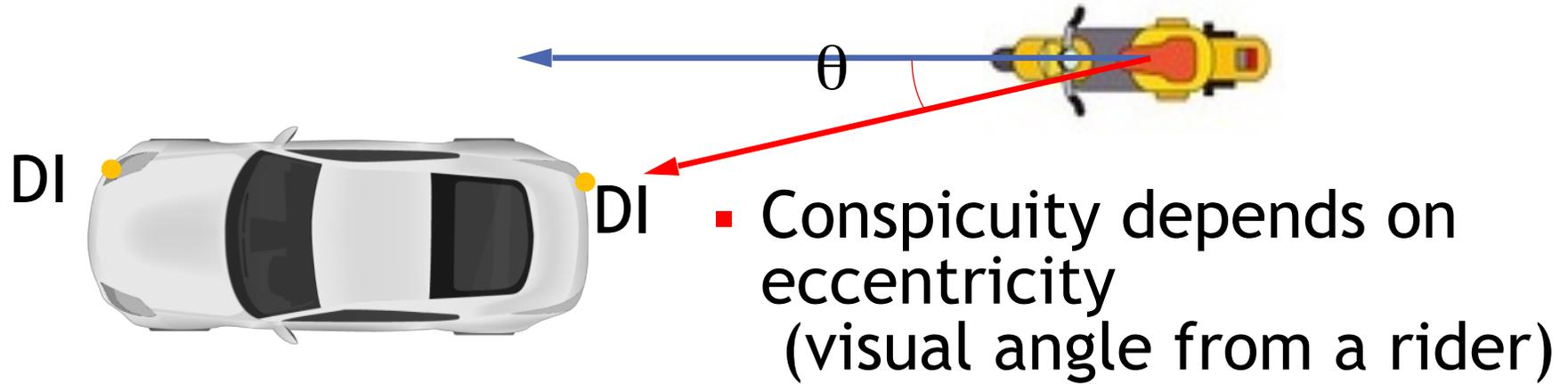


Projected departure warning



Koito Concept

◆ Effective use case of projected direction indicator (DI)



Projected DI
(Blink with DI)



- Projected Signals in Detail

- ◆ Projection is effective before darkness
Full report will be presented at ISAL 2019



10 min before sunset

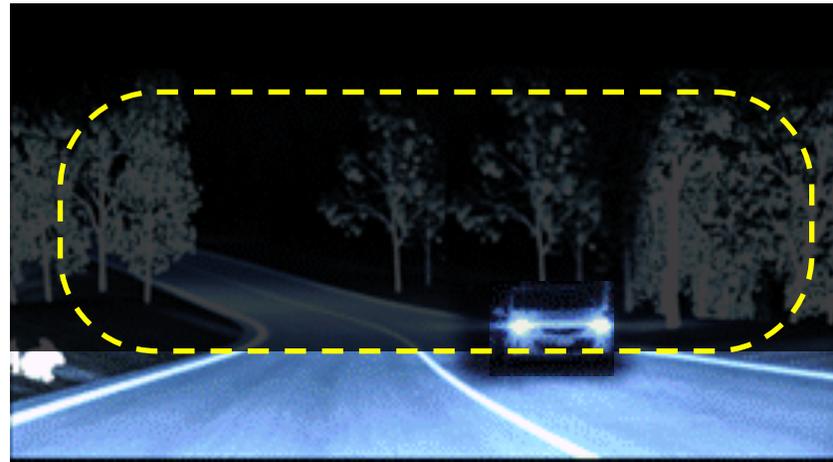


- ◆ Automated driving comes but slower than commercial vehicles
 - Mainstream stays Lv. 2 (2+) for the next decade
- ◆ Penetration of ADAS
 - Sensor integration
 - less sensors to AV
 - styling oriented
- ◆ Fun to drive with safety
 - Lighting as ADAS
- ◆ Safety for everybody
 - Good lighting for economic cars
 - replace halogen to LED
 - affordable ADB* *:Adaptive Driving Beam

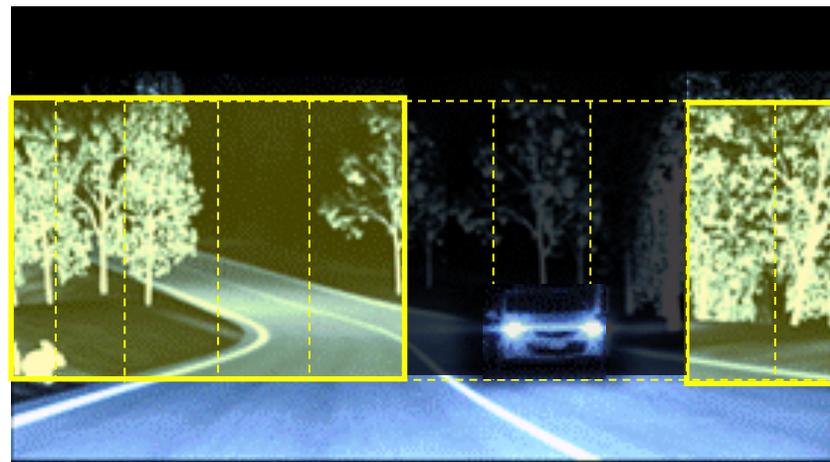
4. Progress on Personal Cars

- ◆ ADB goes to high resolution
- ◆ Millions of pixels available

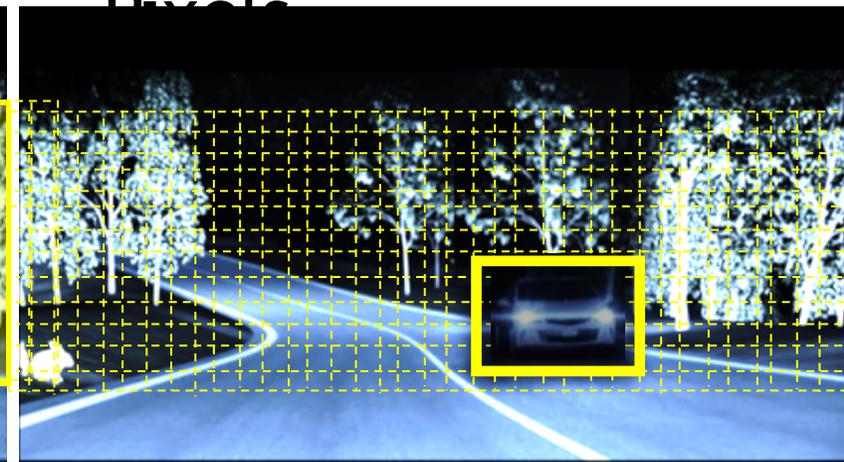
LB/HB



Segments



High-resolution
Pixels



4. Progress on Personal Cars

- ◆ Lighting as ADAS: High-res pixel enables **Symbol Projection**



4. Progress on Personal Cars

- ◆ Lighting as ADAS: High-res pixel helps camera sensors

Dynamic range

Street scenery >> Camera



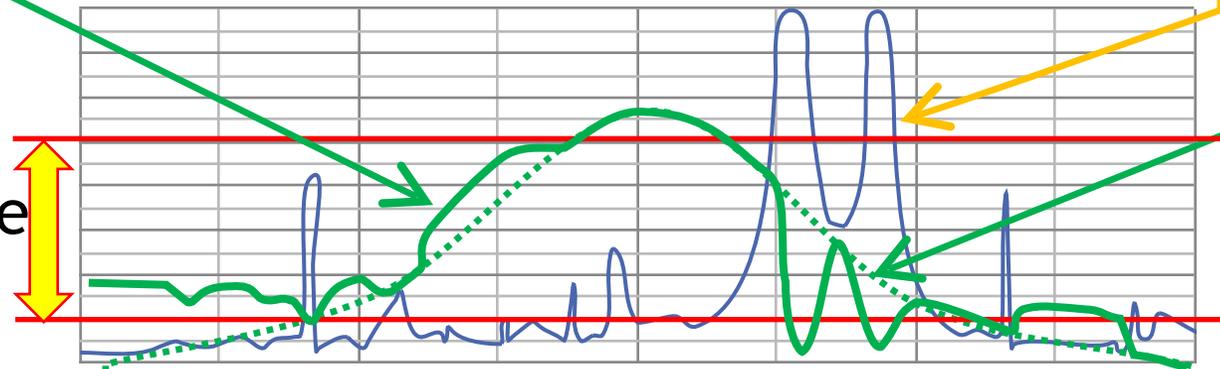
Real time modification of luminance profile of HL

Luminance of scenery

Normal HL

- Compress dynamic range

Dynamic range of camera



4. Progress on Personal Cars

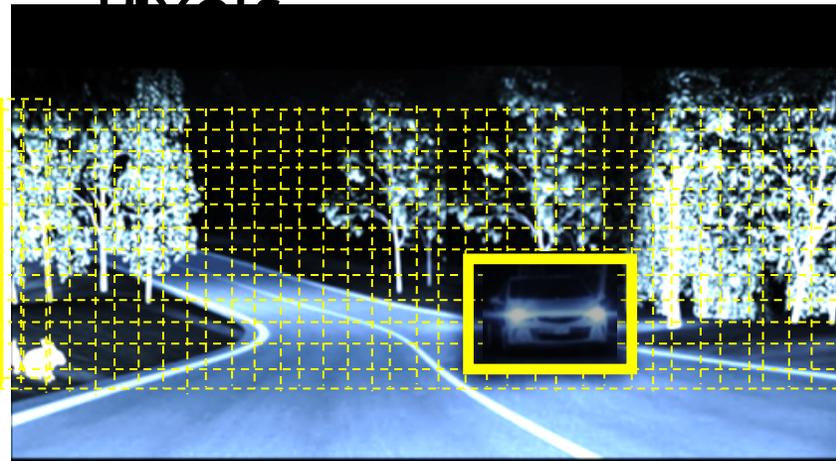
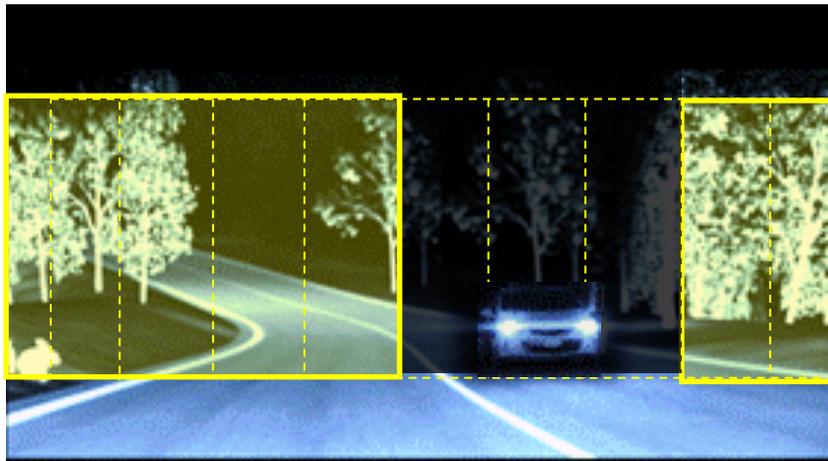
- ◆ ADB goes to high resolution
- ◆ Millions of pixels available
- ◆ How many pixels do we need for ADB?

Horizontal:
Safety, New applications
Vertical:
Comfort, New applications

LB/HB

Segments

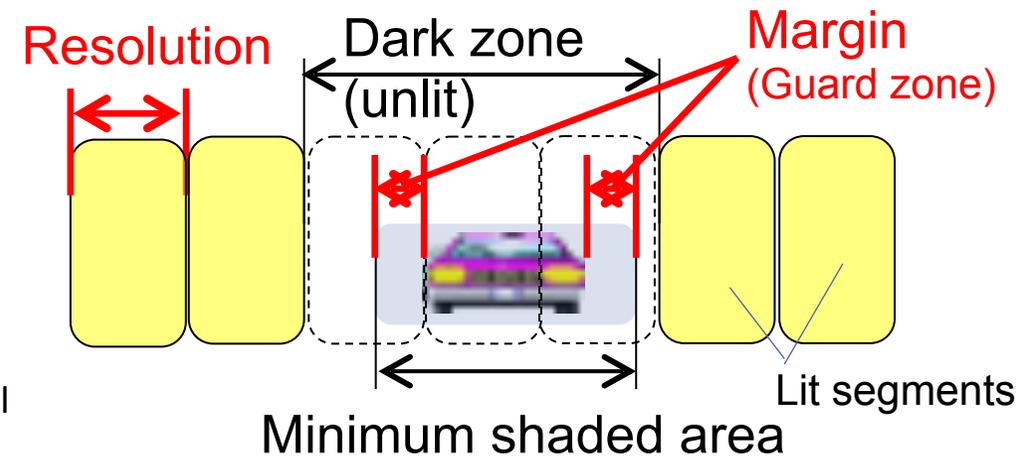
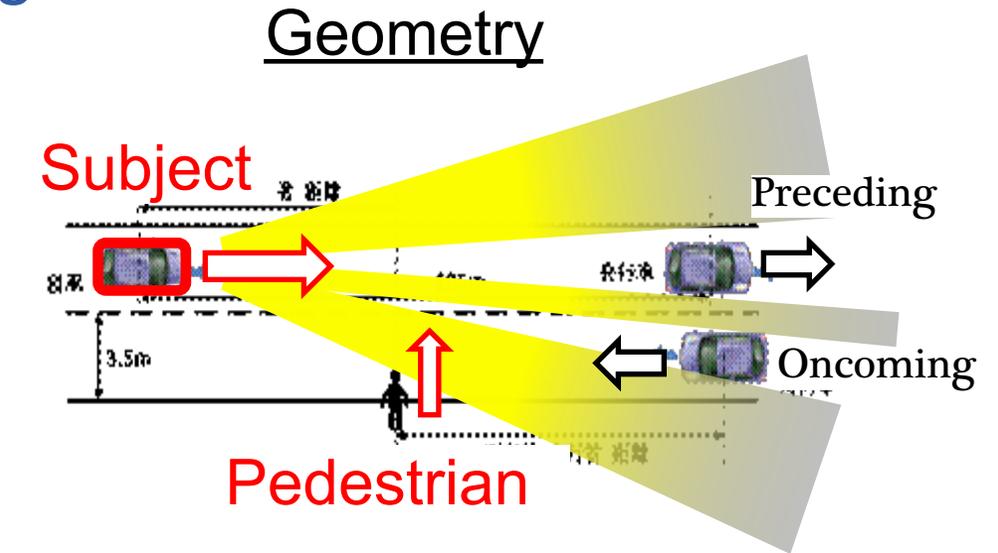
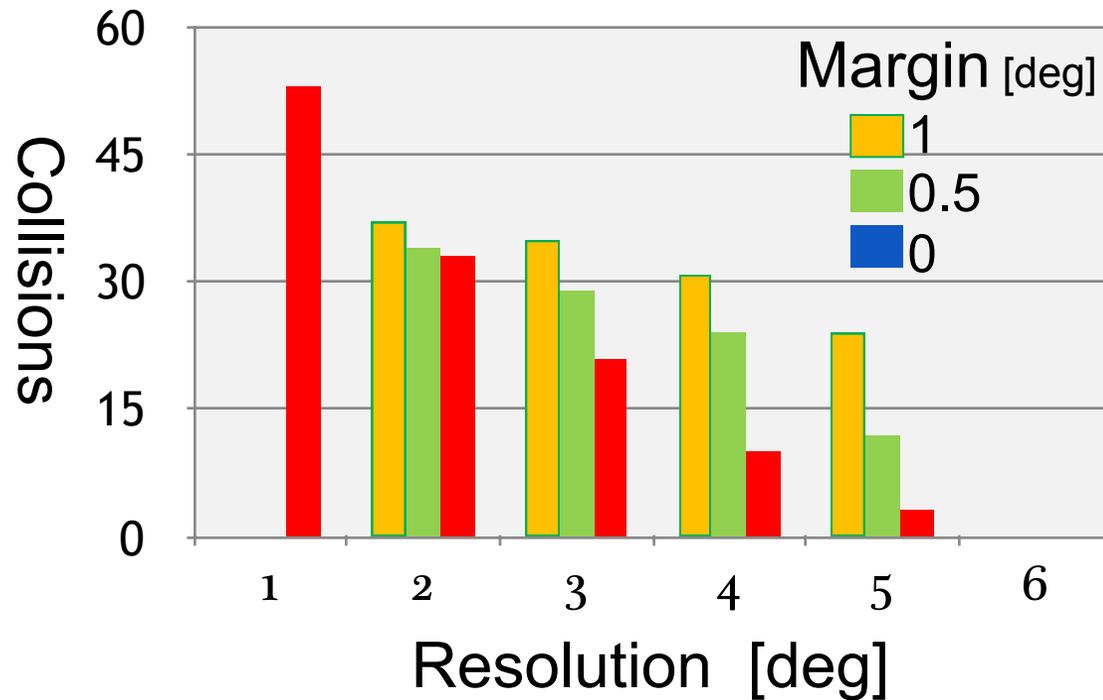
High-resolution
Pixels



4. Progress on Personal Cars

- ◆ Minimized dark zone saves pedestrians

Num. of Collisions vs. Resolution and Margin



Result from traffic simulator "ASSESS" (A Survey Simulator to Evaluate Safety Systems)

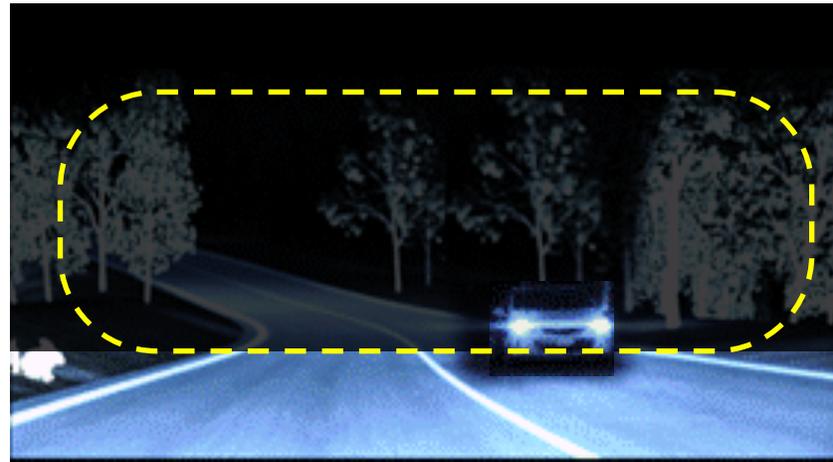
Parameters to be referred to the source.

Source: Compilation from "Quantitative Safety Evaluation for ADB Systems Using a Virtual Traffic Simulator", T. Kitazawa, Oct. 9 2019 VISION Congress, Paris

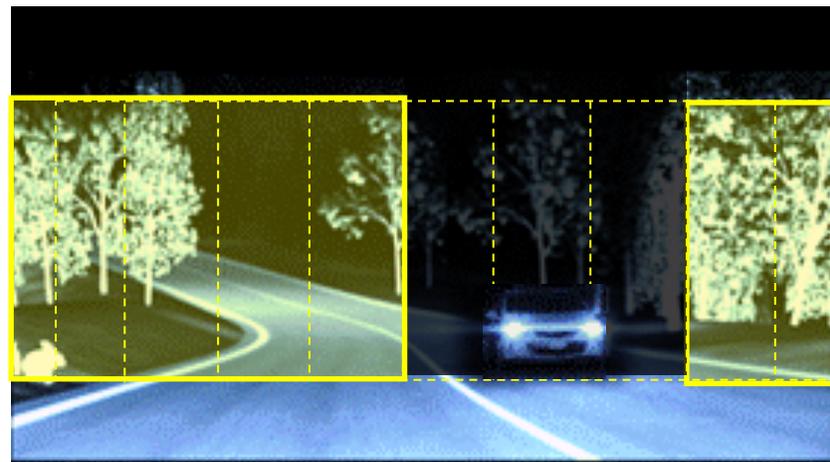
4. Progress on Personal Cars

- ◆ ADB goes to high resolution
- ◆ Millions of pixels available
- ◆ How many pixels do we need for ADB?
- ◆ **Is it affordable?**

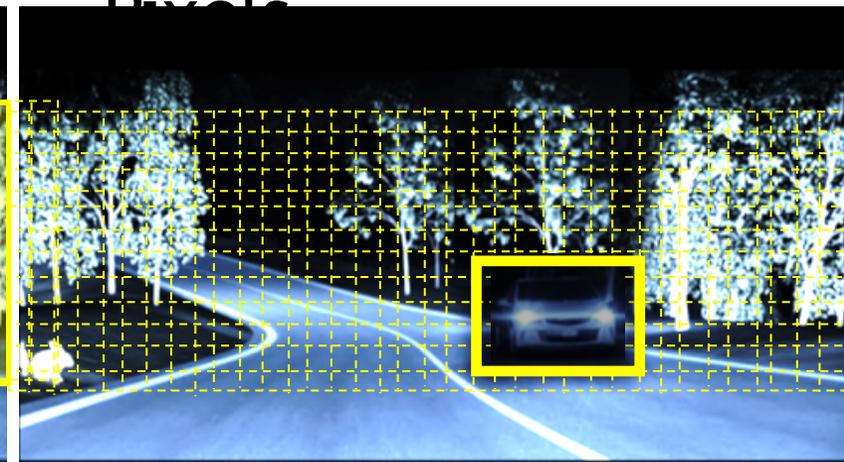
LB/HB



Segments



High-resolution
Pixels



4. Progress on Personal Cars

◆ Smart technology for everybody:

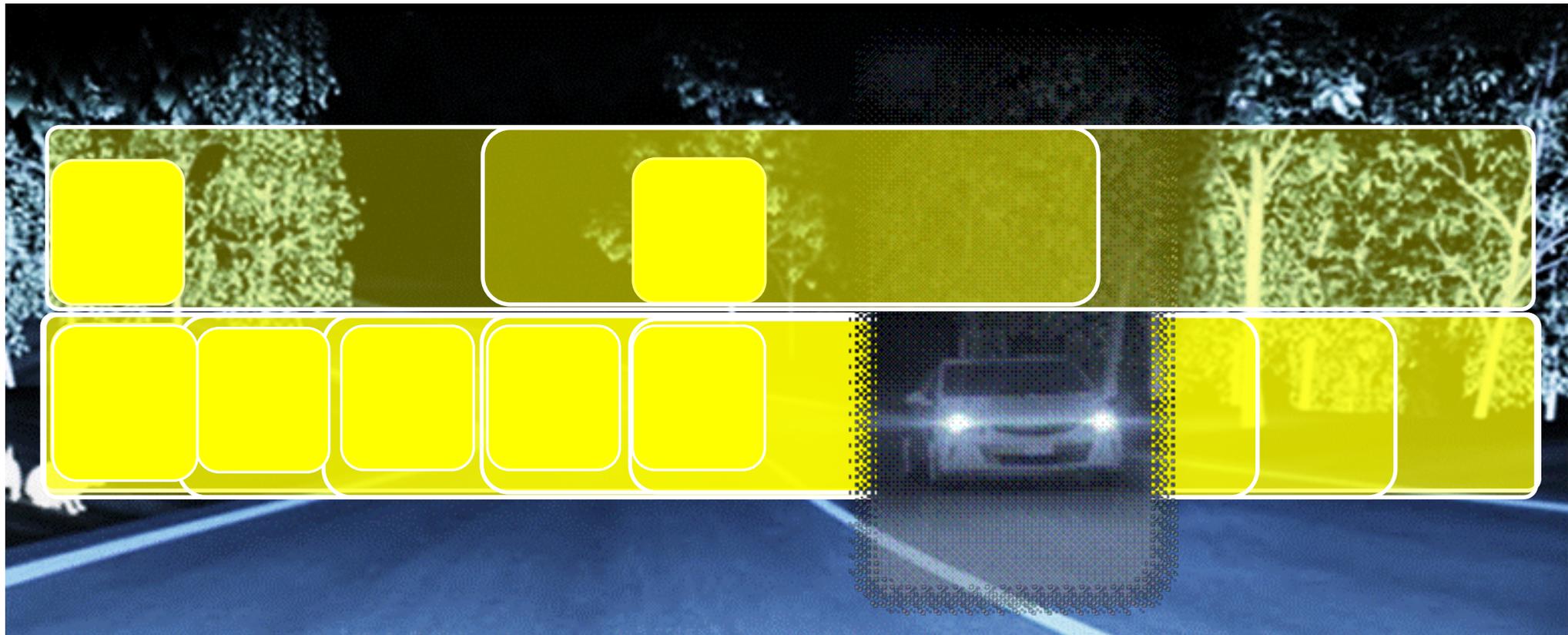
LED

Robust, Low cost

+

Scan

High resolution



4. Progress on Personal Cars

- ◆ Smart technology for everybody:

LED

Robust, Low cost

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Scan

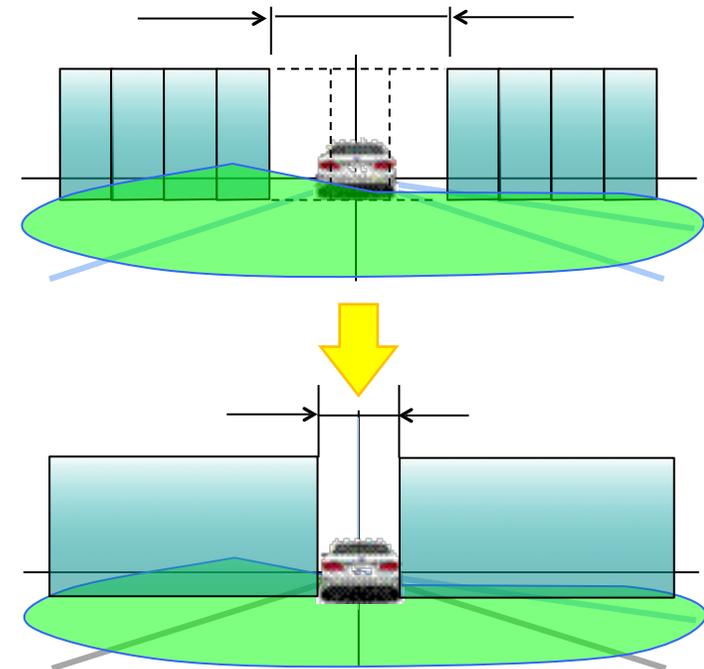
High resolution

BladeScan™ technology

'Blade' Mirror



Minimize dark zone



- ◆ Lamps will contribute for
 - Sensing
 - Communication
 - Progress on personal cars

Safety devices must be affordable for everyone

Thank you for your kind attention

