

# Simple, intuitive, holistic LIV.

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## Agenda

- The vision for LIV
- Technology enablers
- How LIV works
- Lessons learned
  - People are different, preferences are different
  - Baselineing over time is important

"You don't use your car like a smartphone, you literally put your physical safety in its hands, so **shared control** and **collaboration** are core to user adoption of new technology in cars."

**Ola Boström**

*VP Research & Patents, Veoneer*

Meet LIV.



# LIV - The Learning Intelligent Vehicle



Co-driving

Shared control between driver and vehicle

Co-learning

Attain trust required in automated driving

Communicating

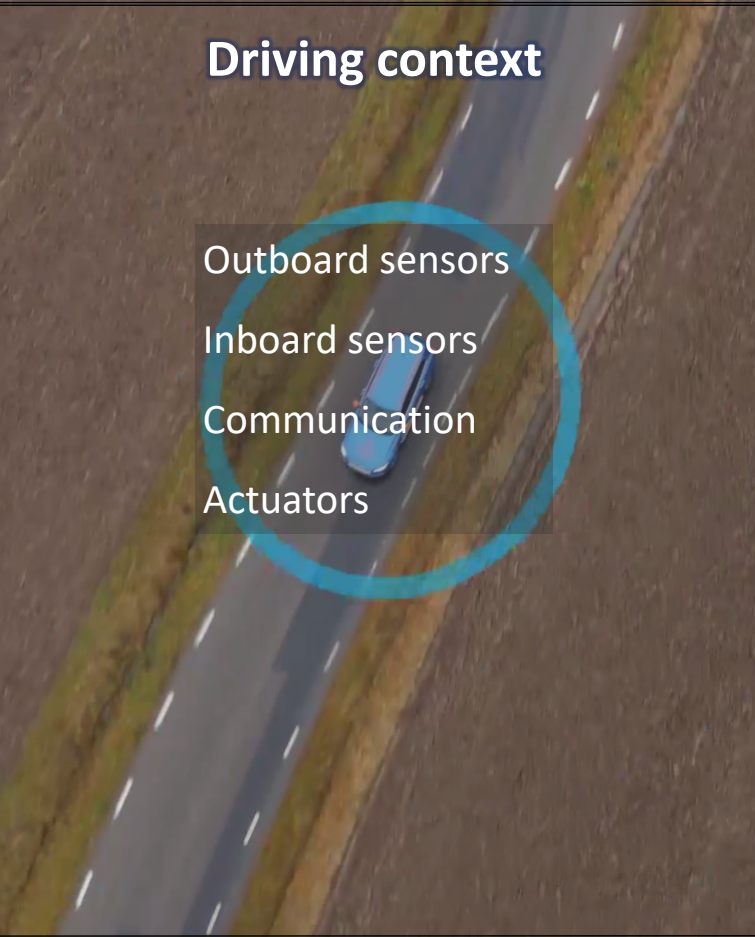
Connecting different technologies in an AI-based ECU

# Vehicle

## AD/ADAS software

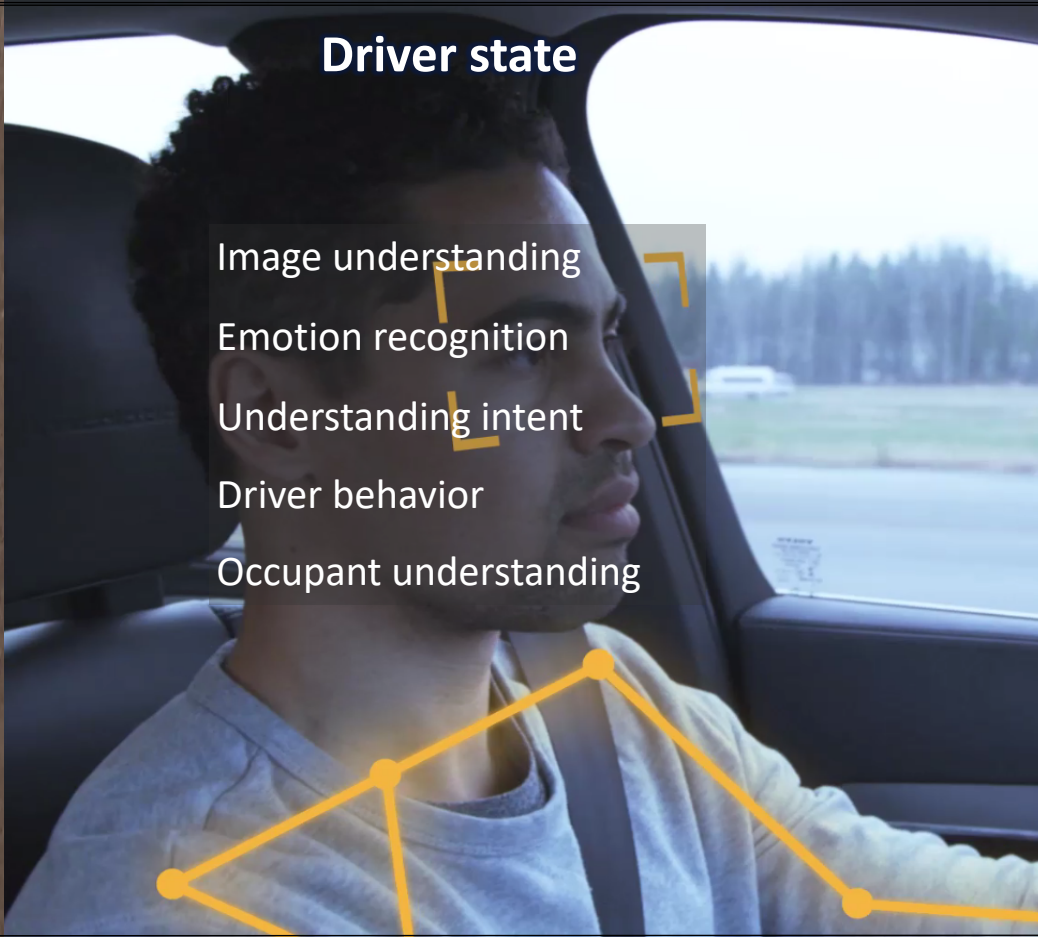
### LIV

#### Driving context



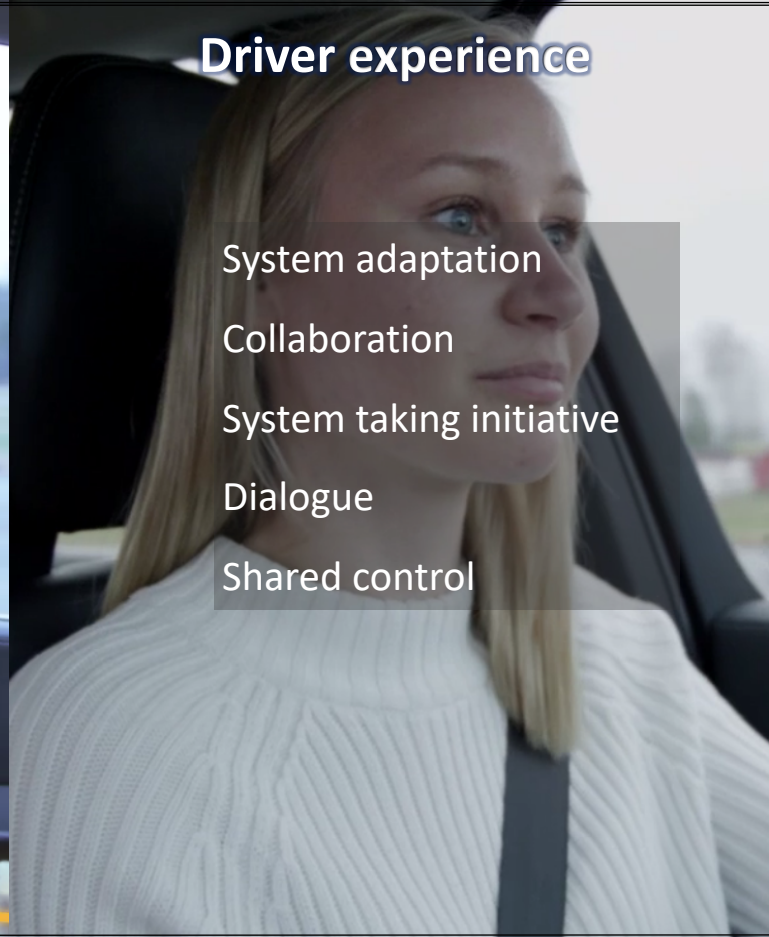
- Outboard sensors
- Inboard sensors
- Communication
- Actuators

#### Driver state



- Image understanding
- Emotion recognition
- Understanding intent
- Driver behavior
- Occupant understanding

#### Driver experience

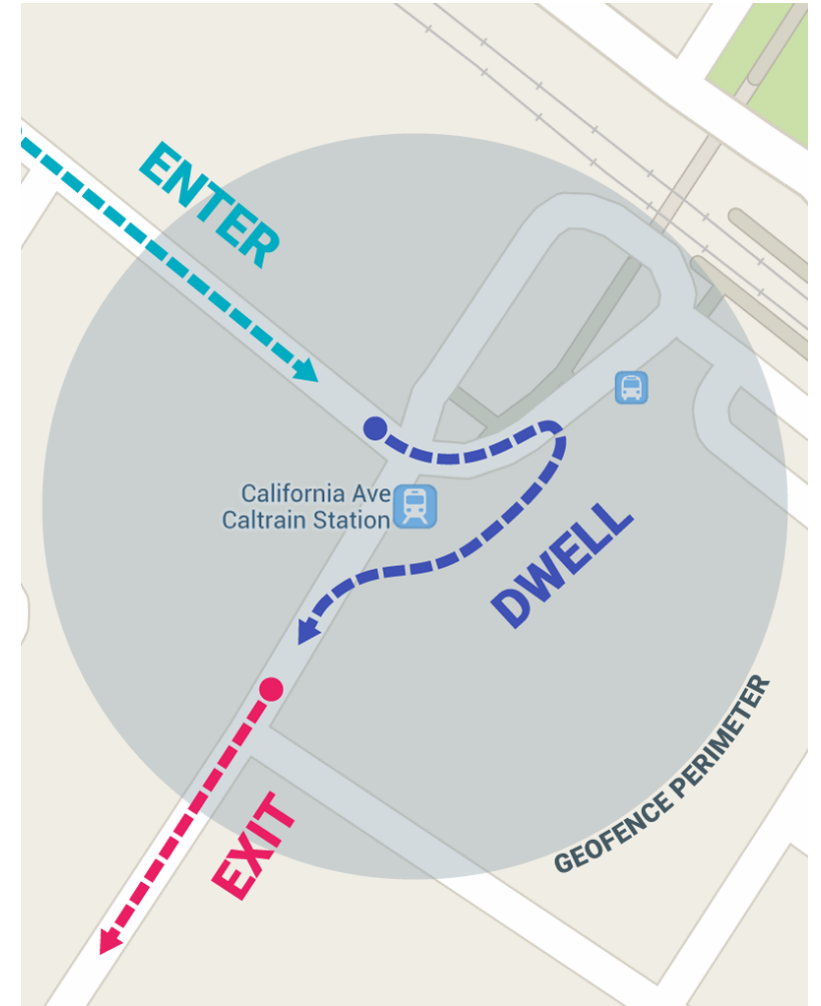


- System adaptation
- Collaboration
- System taking initiative
- Dialogue
- Shared control

# New Technology Enablers

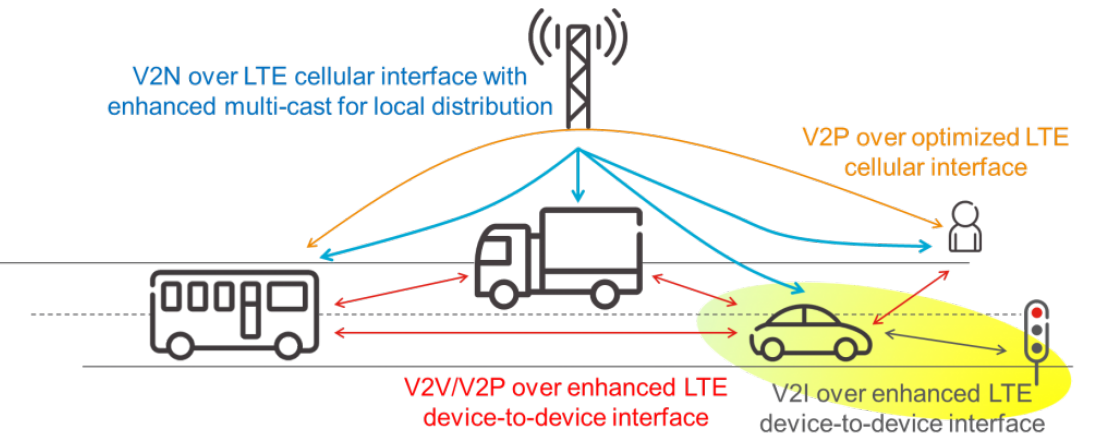
## GPS and geofencing

- We see geofencing as an enabler of not only automation and automation collaboration, but mobility in general. Imagine being able to move people and goods without needing to worry about lack of V2X capability, as all those within your area will be equipped.



# Cloud solution

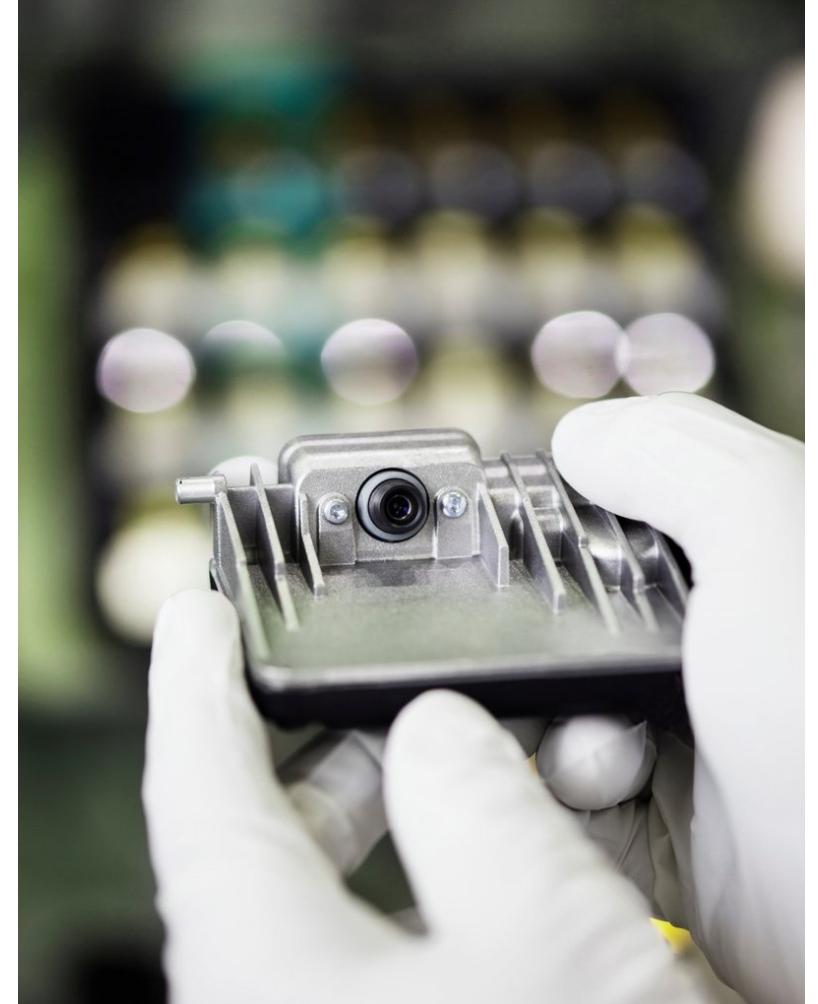
- For our smart city at CES, we also have a cloud solution, providing an overview of not only connection quality but also providing an extra level of usability for LIV, assisting the vehicle in tricky situations





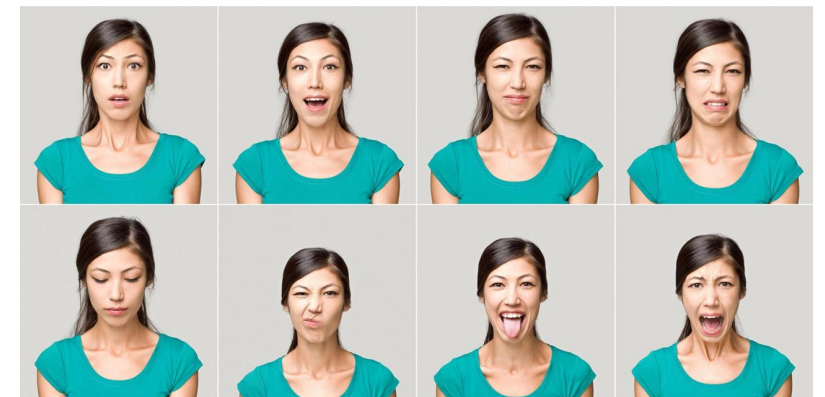
## Capability communication

- We trust our sensors, but we appreciate that for drivers to trust their vehicles we need to know – well in advance – when systems are not functioning optimally
- We have developed novel ways for sensors and systems to communicate their capabilities, and also communicate this to the driver



## Gaze, facial expressions, cognitive load

- Driver attention and distraction are of course of interest and pivotal for understanding driver attention
- LIV uses knowledge of your mental state – facial expressions and gaze – to understand what you as a driver are receptive to at each moment, as well as your responses to moments of truth



# Driver Trust and Collaboration Inputs



# Live screen CES

- This is part of Veoneer’s current research into trust in mobility
- Veoneer Research see a need to understand the two-way trust between the car and the driver, and how it develops
- Not only does the driver need to trust the car, but the car also needs to trust the driver
- Trust will develop over time as driver and car get to know each other

Annika  
Manual Drive

Driver engagement

High

Low

## Driver trust

The driver's trust in LIV

- Manual drive
- Autonomous drive



## LIV trust

LIV's understanding of the driver



## Collaboration foundations

- LIV Trust:
  - How much does the car trust you?
- Driver Trust:
  - How much do you trust the car?



# LIV Scenarios

# Communicating

- System also takes initiative for dialogue
- Communicate system/sensor state
- Adjust modality according to driver attitude as well as safety

**Risk Mitigation for  
Driver Distraction**



## Co-driving

- Communicate system and vehicle capabilities while driving
- Understand driver intention and adjust accordingly
- Seamlessly and naturally work with the driver

## Collaborative Intersection Assistance

## Co-learning

- Learn driver preferences and remember them
- Interpret and learn driver intent
- Learn driver expectations

## Integrated Safety

# In Cabin Monitoring

Shared control between  
driver and vehicle

Attain trust required in  
automated driving

Connecting different  
technologies in an  
AI-based ECU



# Thank You!

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