

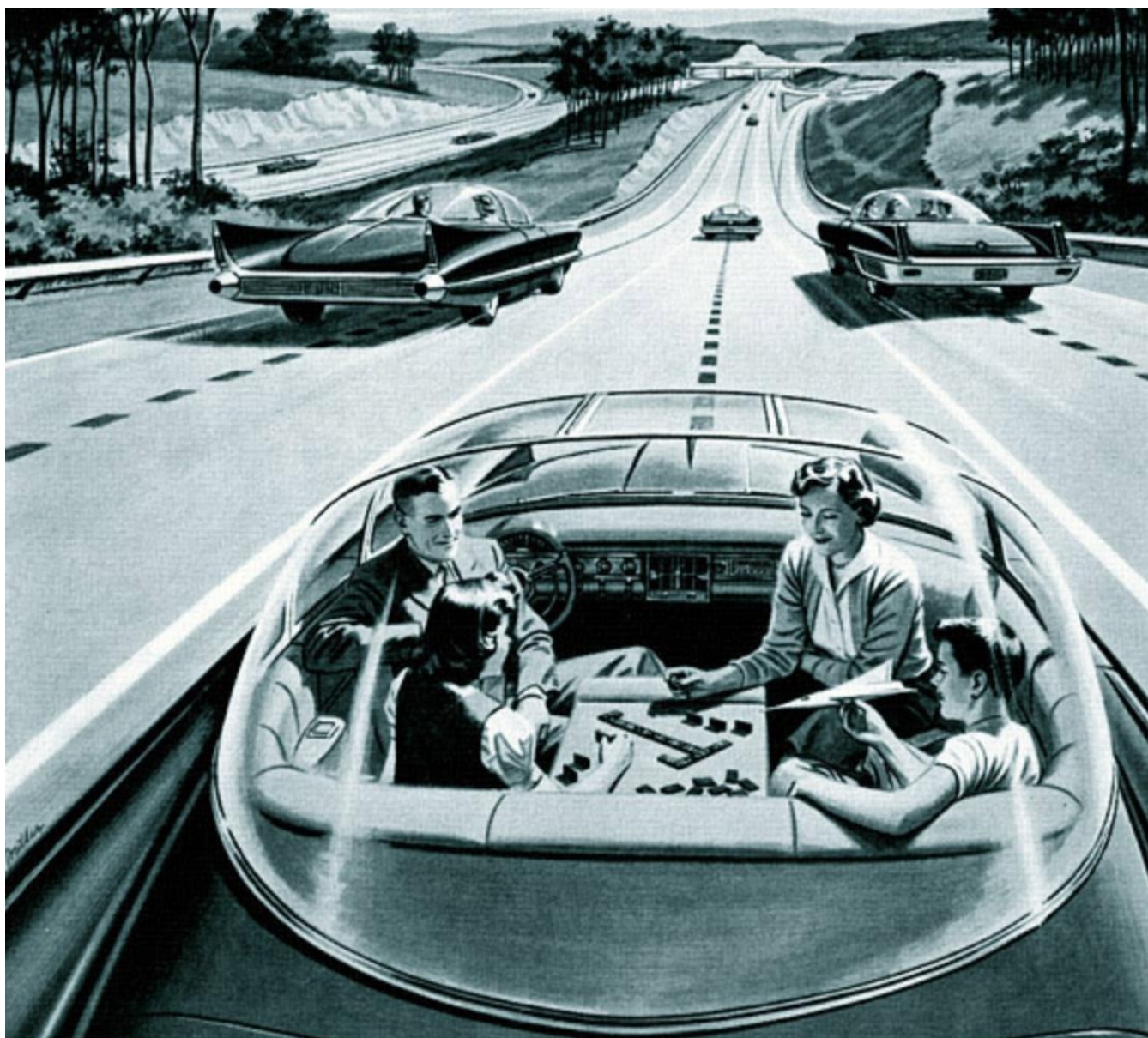
# Selvkørende biler

Jens Peder Kristensen  
KeyResearch

[jpk@keyresearch.dk](mailto:jpk@keyresearch.dk)

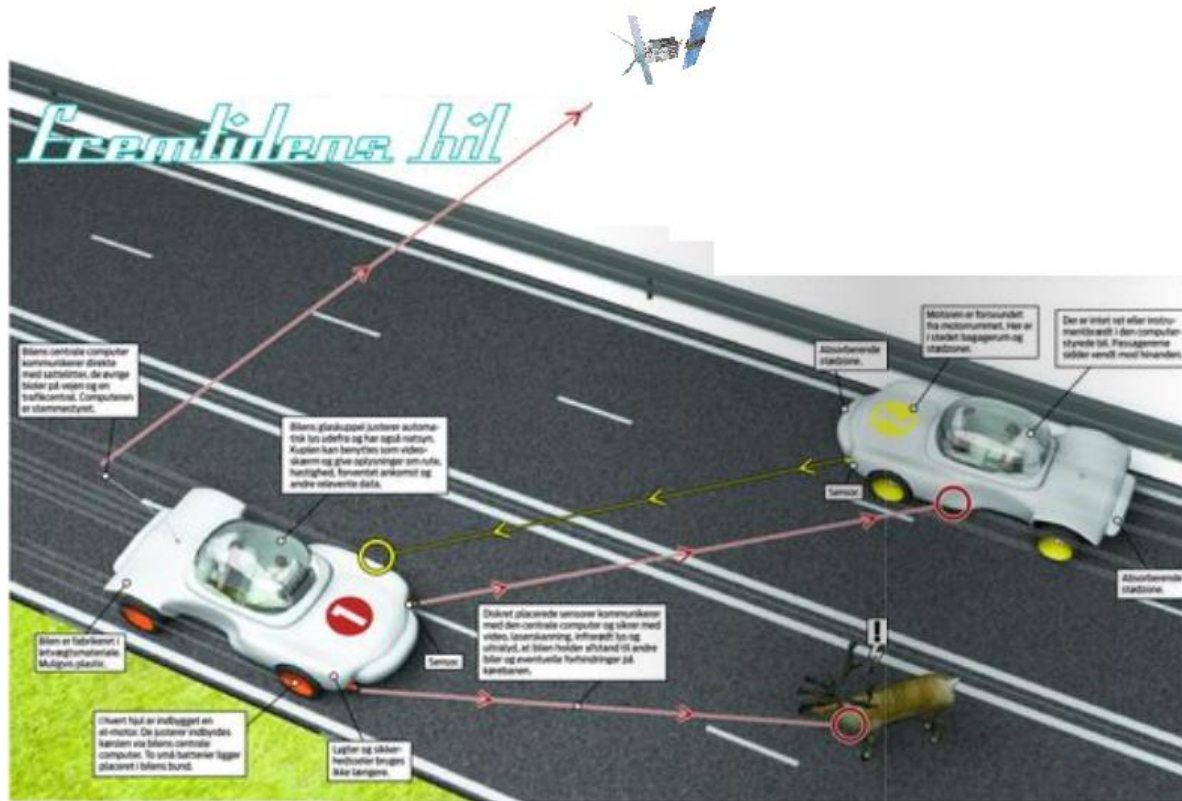
Tel: 22 23 11 16

# Vision 1956



# 2008, 30 year vision

## 2014, 5 year vision



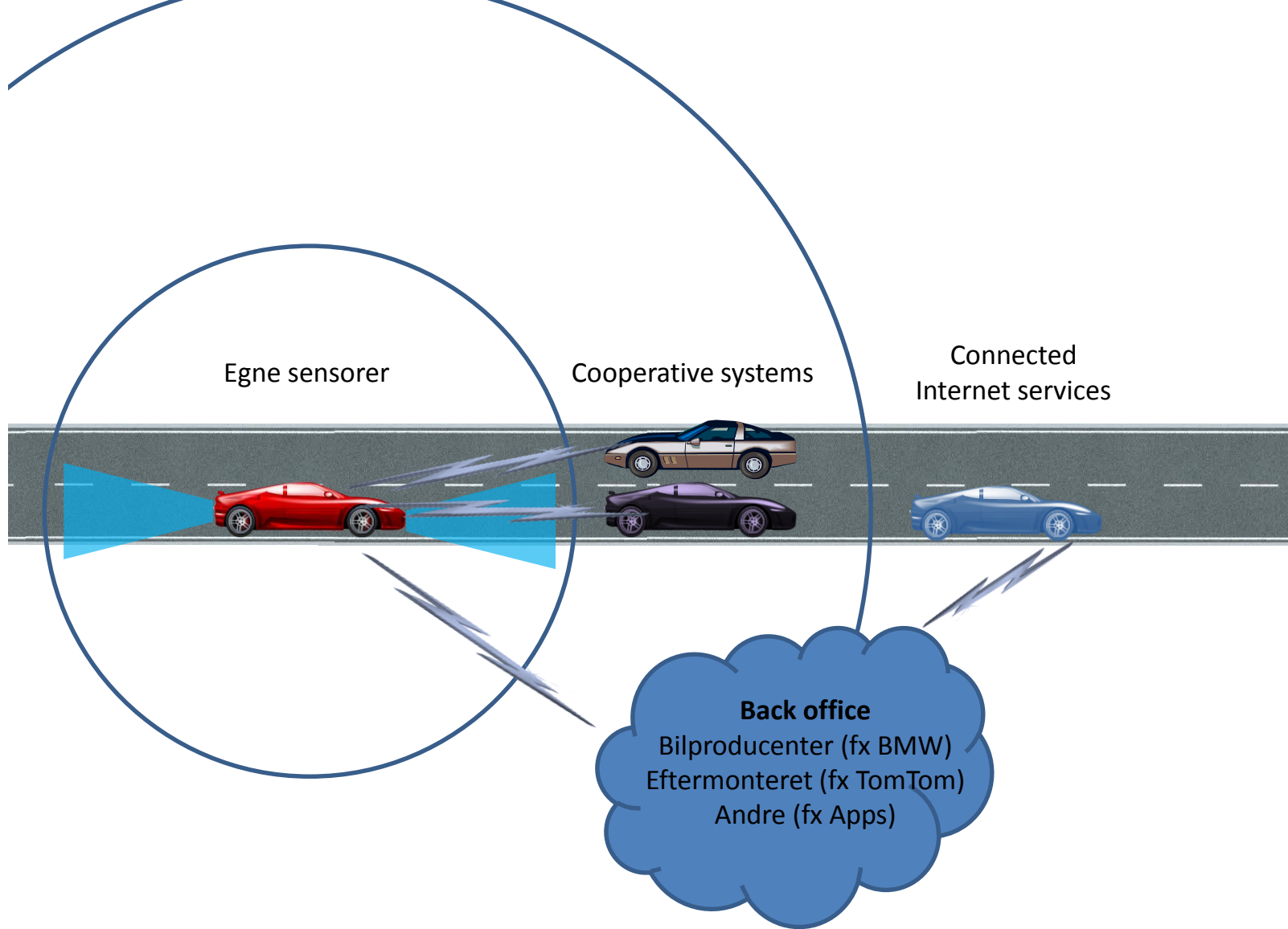
# Ingen rat og pedaler



# Fremtidens bil

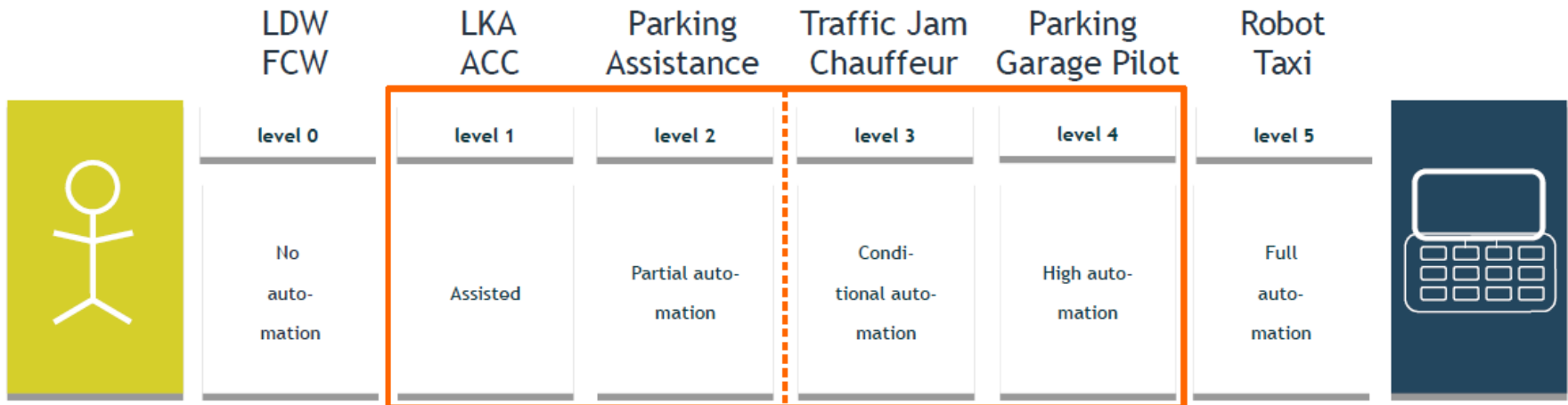
- Connected = always on
- Co-operative = taler med de andre biler og infrastrukturen
- Automated = overtager bilistens opgaver





# // The Adaptive project

## Levels of driving automation



### Driver in the loop

- No significant change with respect to existing driver assistance systems

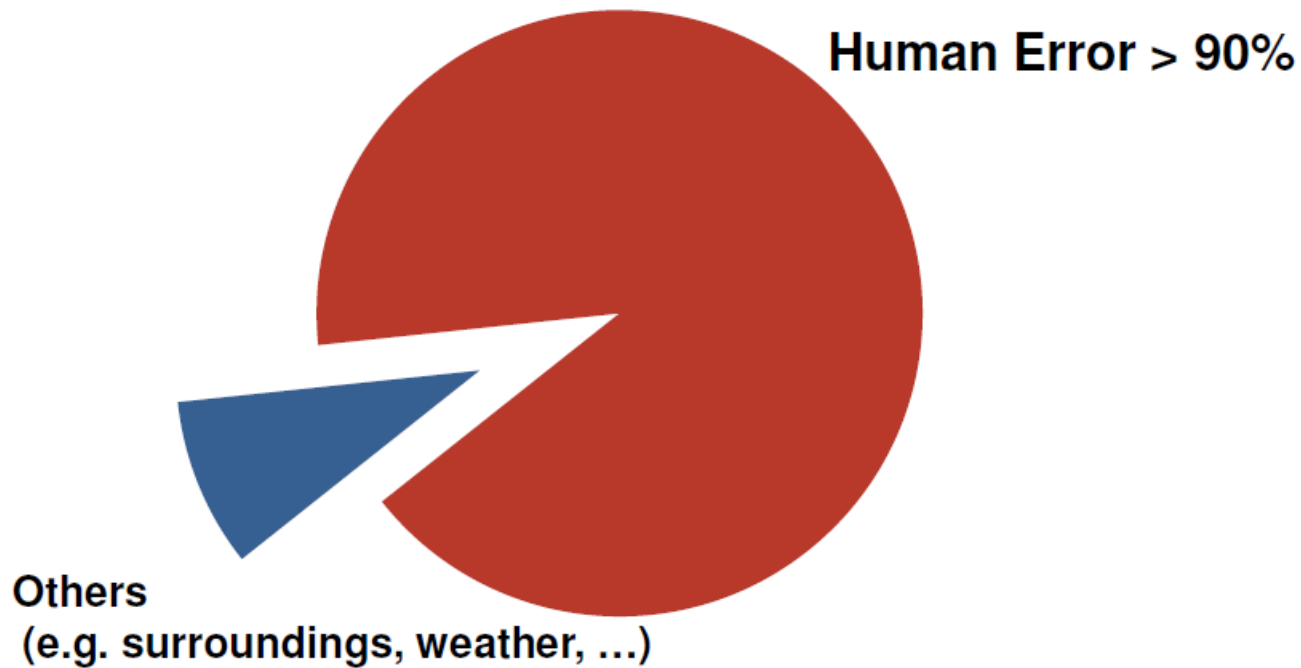
### Driver out of the loop

- Not in accordance with regulatory law (Vienna Convention, national road law)
- Extra risk with respect to product liability
  - need for action

# Fordele



# På vejen



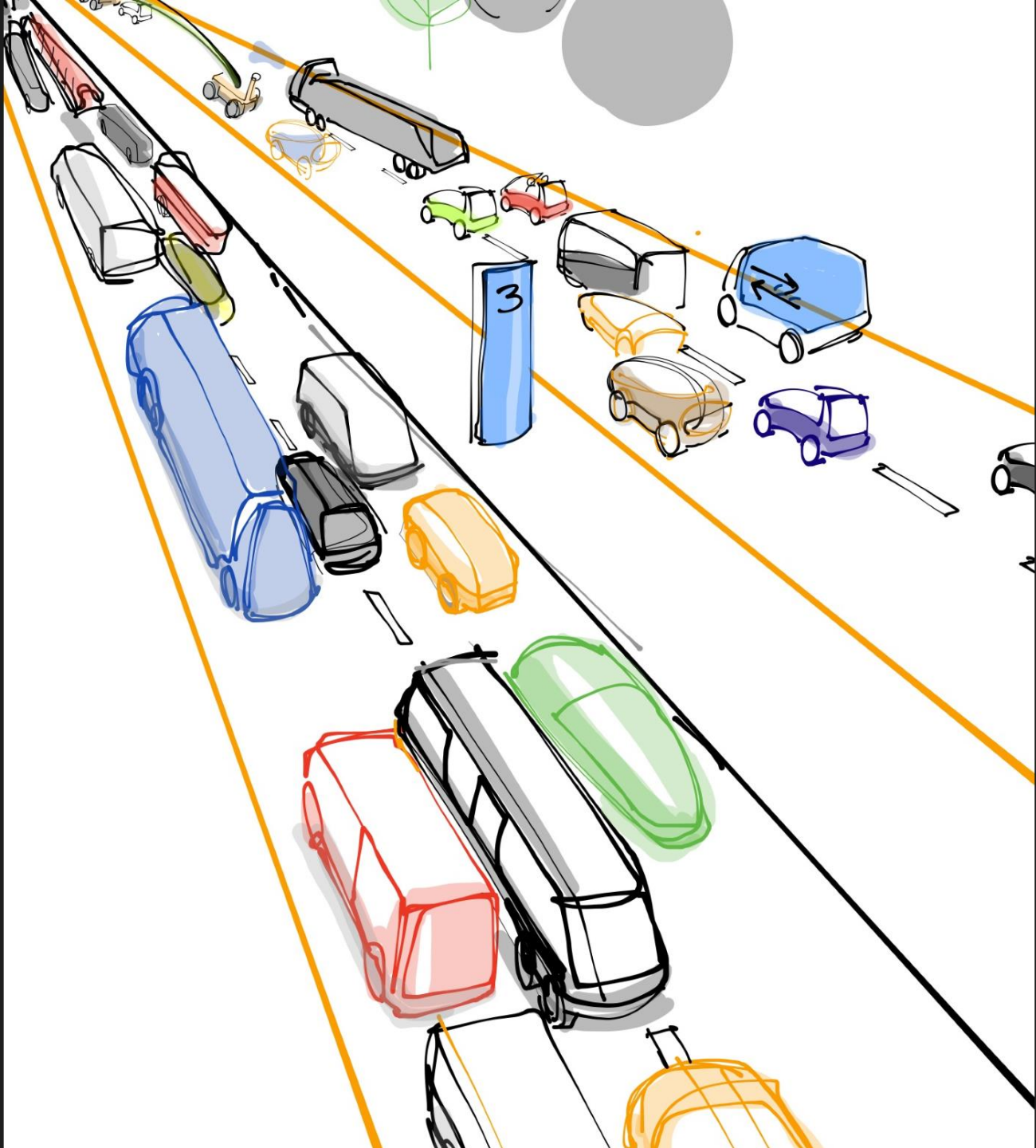
Source: GIDAS Database

# Brændstoføkonomi

- 4-10 % besparelse
- Takket være forudseende og rolig kørsel
- Sving, bakker, signalanlæg er kendt og indregnes i kørslen.
- Tæt kørsel giver 20-30 % reduktion

# Mobilitet

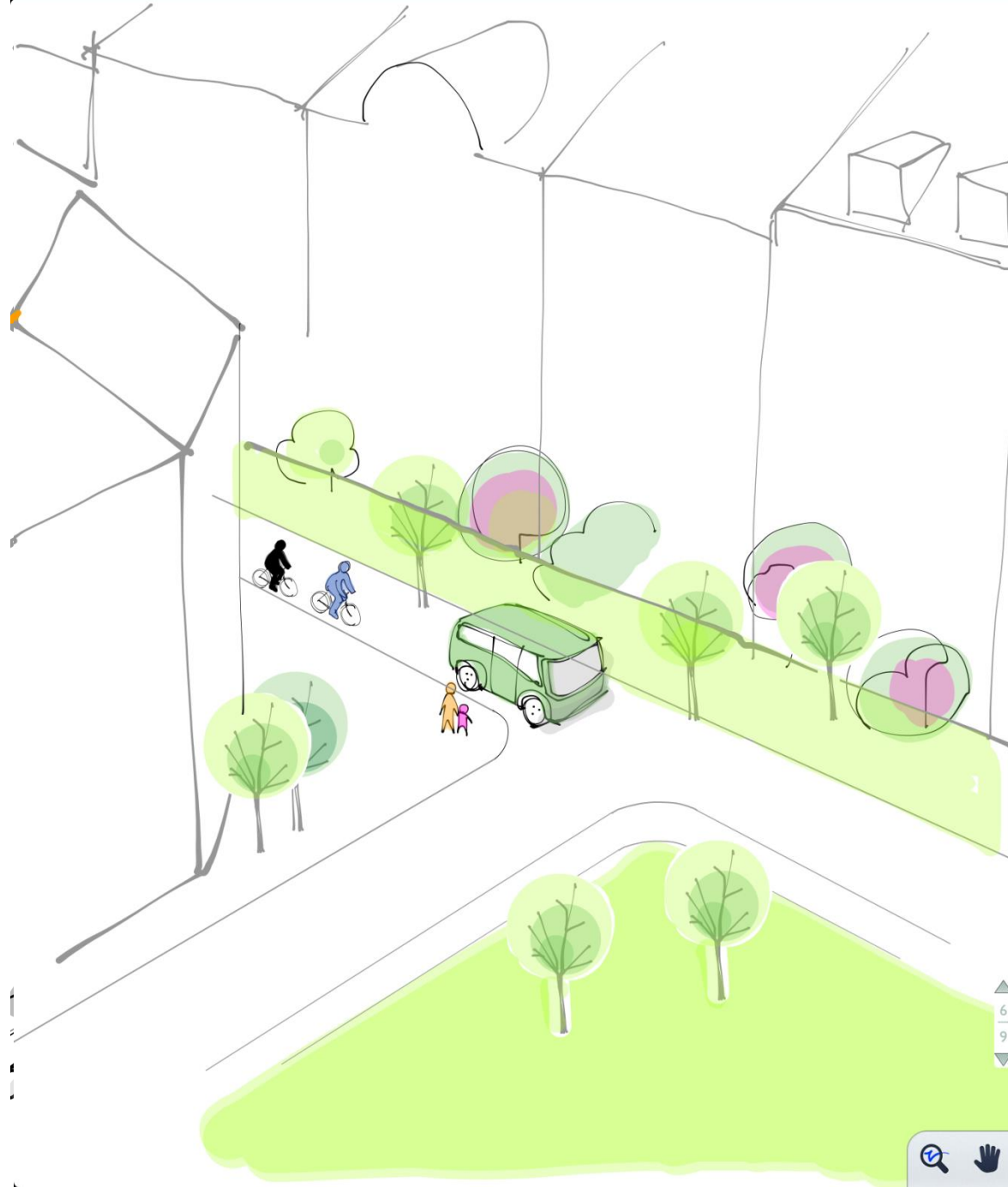
- Fysisk handikappede
- Blinde
- Personer uden kørekort
  - Mistet det
  - For unge
- Ude af stand til at køre



# Fordele

- Hurtigere gennem signalanlæg
- Billigere transport da chaufføromkostning forsvinder
- Køretiden kan anvendes nyttigt

# Byen



# Job tab

- Chauffører
  - Taxi
  - Lastbiler
  - Busser
- Uheldsøkonomien
  - Forsikringer
  - Værksteder
  - Sundhedsvæsen



# Barrierer

# Lovgivning

Art. 8.5: "Every driver shall at all times be able to control his vehicle or to guide his animals."



I 2014 har U.N. Working Group on Road Traffic Safety lavet en tilføjelse så en bil må køre sig selv så længe at systemet "can be overridden or switched off by the driver"

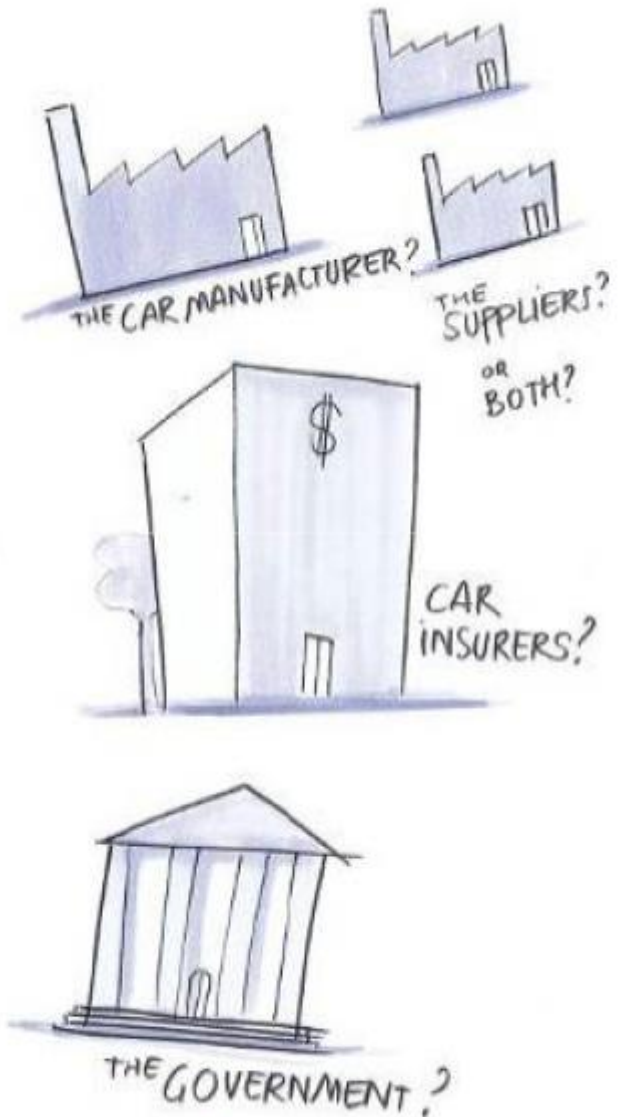
# [ Liability

The vehicle manufacturer is obliged to deliver a product that is fully tested in all situations and under all circumstances.



THE DRIVER?

The driver remains in control and must be able to overrule the system in any situation.



# [ Human Factors questions

- Who is in control?
- How will I know this?
- Can I trust it?
- Is it acceptable and reliable?



## · Possible consequences

- Loss of skill
- Loss of situation awareness
- Changes in workload: e.g. Under load followed by *excessive overload* in critical situations.....

Adapted from Flemisch et al., 2008; Kaber & Endsley, 1997

# Test

- Hvordan tester man en selvkørende bil?
- Google har kørt næsten 1 mio. km
- Hvor langt kører 1 mio. Polo'er på 1 minut?
- Nødvendigt at køre 100 mio. km?
- Hvad så efter en lille software ændring?
- Hvor meget må foregå i en simulator?

# Road maps

- Volvo trucks way
- Google way
- Bosch parking
- Bosch driving

# Volvo trucks



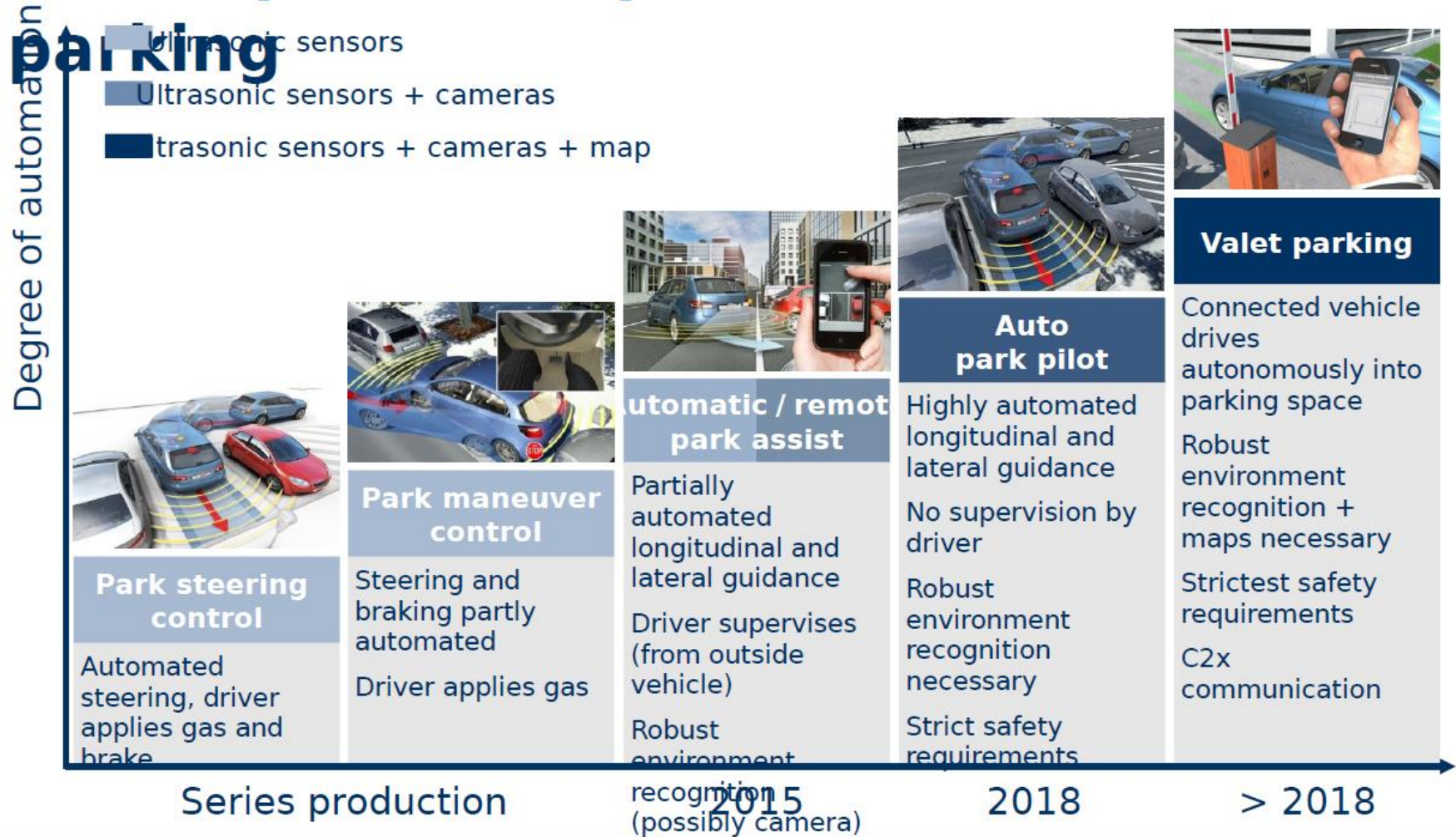


# Google way

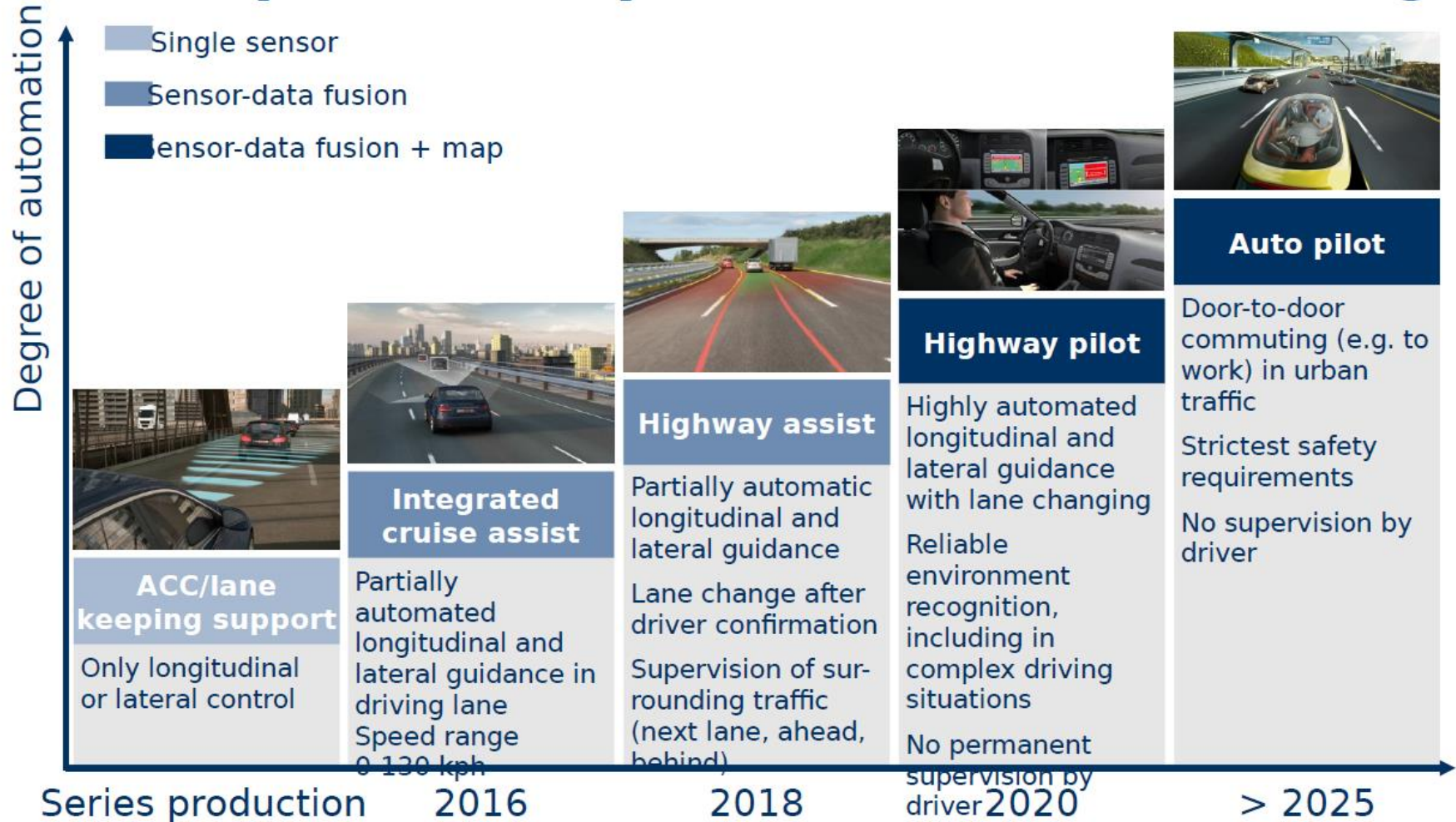
- Kendte veje (10 cm 3D model)
- 40 km i timen
- 70.000 \$ laser skanner

# Toward Fully Automated Driving

## Development steps - automated parking



## Development steps - automated driving



# Spørgsmål vi skal stille os

- Bygger vi overflødige veje?
- Lægger vi overflødige skinner?
- Bygger vi overflødige broer?
- Bygger vi byerne forkert?