



# Automatic Vehicles on Public Roads

## Lessons learned

# WEpods?

## Automated driving vehicles on public roads in Gelderland - NL

- Track: 11 kms - on University Campus and to railway station  
in mixed traffic, using infrastructure as it is,  
but traffic light + wifi-p  
local ban on double parking  
selected on: limited speed differences  
limited traffic complexity
- Low speed: max 25 km/hr so far. 50 km/hr is planned
- Special: testing on public roads from Day1  
cooperation R&D, Gov, Private Comp's



# Unmanned?



## Human on distance

Operator: in the Control Room  
3 camera views  
intercom inside / outside



## Human in the vehicle

Steward: for supervision  
for legal compliance

# Project content

## Kit on existing vehicle



### Base vehicle:

Easymile EZ10



Future?



### Additions:

- D-GPS/RTK + INS + Odometry
  - 6 multilayer lasers for localization and object handling
  - 9 camera's + 9 radars
  - 5 computers (3x Drive PX)
  - control panel
  - interior camera, interior + exterior intercom
  - 4G + 3G + Wifi-P communication
  - ticker tapes front + rear
  - 12KWH batteries
  - belts, head rests, roller chair fixation, wiper, 3rd brake light, int. covers, steward seat, horn, heater
- 
- Supervisor system
  - User App

# Where?

## So far and Planned



2016 > - Wageningen Campus ➡ Ede train station

Lessons Learned

2017 - Delft University Campus



2018 - Airport Weeze

Lessons to be learned

2019 - Aachen ➡ Vaals / cross border

- NordRhein Westfalen
- Larger vehicle
- Higher speed



# Main challenges



Navigation:	follow the road and lane: localization, map making, path planning +/- 20 cm accuracy
Handling other traffic:	detect, track, predict path + classify combine with ego motion risk assessment corrective action: brake

# Human factor

## Crucial to success



### Passengers: Feel Good

- Intercom
- Infotainment
- Belts
- E-stop button
- (Steward)
- Wiper
- Climatization
- Wifi modem
- Comfortable seats

### Other road users: Reaction/Attitude

Tools:     Shape, ticker tape, intercom,  
                 cam, blinkers  
                 Neighborhood communication

WEpod:    keep distance  
                 be patient

Risk:       sudden brake action (WEpod)  
                 close cut in actions  
                 jokes/misuse

# Legal permit



RDW Waiver for (permanent) use on public roads (with passengers)

- Special, customized, procedure; based on Safety Case
- RDW, SWOV, Ministry of Infrastructure and the Environment

## Conditions

- Only on defined track
- Test: steward (licensed/registered) + test engineer
- Passengers: safety instructions + all seated & belted
- Logbook



First permit for Automated Vehicle in public area in Germany (Hannover - June)



# Lessons Learned

## About Technology



- D-GPS-RTK is not enough; use dual (or triple?) localization
- No existing maps are accurate enough
- Building a system on SIL2 certified components doesn't work in traffic
- Most problems are in the interfaces

*At boundaries of innovation you have to solve problems yourselves.*



# Lessons learned

## About Testing on Public Roads



- Testing on public road is possible in a safe way
- Select your circumstances and anticipate traffic
- Always have 2 people during testing and 1 finger on the red button
- Communication to traffic, by ticker tape, is very important.

*Speed seems higher and trees seem closer in an automated vehicle*



# Lessons learned

## About Public reactions



Positive attitude: public, authorities, companies, press.

Pedestrians: take out their smartphone

Bikers: pass at all sides when driving low speeds.

Cars: good patience

Biggest risk: some think the vehicle will always brake

One objection: NIMBY



*Automated driving makes you feel more relaxed*

# Lessons learned

## About getting a Waiver



- Automated vehicles don't fit a current vehicle category
  - Attention to the known issues: lights, EMC, etc.
- Proposing a procedure worked very well
  - We started with the department that executes rules, not develops rules
- Certification is a process not a test.
  - Road authority not used to process or valuating a Safety Case dossier

*Our cooperation with the NL road authorities is Super*



# Self Driving vehicles .....

## Statements for discussion



provide the missing link in public transport  
need a permission instead of a waiver  
will be street-legal in 3-5 years from now  
will improve quality of (urban) life  
will put lawyers out of job.  
will revalue the importance of traffic rules







INTERREG  
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TU Delft

RC ROBOT CARE SYSTEMS

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Future  
Mobility  
Network