Automatisch Vervoer op de Last Mile

Festival van de Toekomst
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- Human Factors of Automated Driving (ITN)
- WEpods driverless shuttles
- Dutch Automated Vehicle Initiative

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Hands free

- Cruise Control
- Automated lane following
- Eyes off road
- Capable driver
- Highway "now"

Driverless

- No steer & pedals
- User selects vehicle & destination
- Constrained routes
- Low speed

Interacting with normal traffic

Dutch Automated Vehicle Initiative

DAVI ONTHEROAD

To investigate, improve and demonstrate automated driving on public roads

- Assess & improve technology
- Study human behaviour
- Prove safety
- Pursue legalisation
- Create public awareness

DAVI DEMO November 2013
Innovatie Estafette RAI & A10 Amsterdam

TU Delft TNO innovation for life Connekt AutomotiveNL

DAVI related projects & partners

DAVI *open initiative*	*TU Delft, TNO, Connekt, SWOV, Un Twente, Fontys, Hanze, HAN, RUG, Toyota Motor Europe, NXP, Imtech, Royal Haskoning DHV, VisLab, SKF, Technolution, Almende, V-tron, Trinité, Mapscape, DLR, TRL, ITS-Leeds, Un Southampton, RWTH*
Human Factors of Automated Driving (HFAuto), Marie Curie ITN FP7	TU Delft, TU München, Un Southampton, Un Twente, Chalmers Un of Technology, IFSTTAR, VTI, Volvo Truck, Volvo Car, BMW, Jaguar, Toyota Motor Europe, Continental, TNO, SWOV
Truck Merging Support, STW-HTSM	TU Delft, TU Eindhoven, DAF, SKF, TNO, NXP
From Individual Automated Vehicles to Cooperative Traffic Management (IAVTRM) STW-OTP	TU Delft, Toyota Motor Europe, TNO, NXP, Imtech, RDW, Connekt, SWOV, Technolution, Almende, V-tron
Standardized Self-diagnostic Sensing Systems for Highly Automated Driving (S4-DRIVE) STW-OTP	TU Delft, NXP, TNO, Toyota Motor Europe, Tata Motors Europe, Technolution, InnoSenT, Melexis
Taking the Fast Lane STW-OTP	TU Delft, NXP, Rijkswaterstaat, SWOV, Technolution, TomTom, DLR
WEpods Driverless Public Transport	**Province of Gelderland**
Safe interaction of automated vehicles with vulnerable road users (SafeVRU)	TU Delft, Province of Gelderland, TNO, NXP, 2GetThere, SWOV, RDW

WEpods

driverless shuttles in the Netherlands

provincie Gelderland

DAVI ONTHEROAD

TU Delft

ROBOT CARE SYSTEMS

RICARDO

Technolution

spring innovation management

mapscape

ZTI

EASY MILE

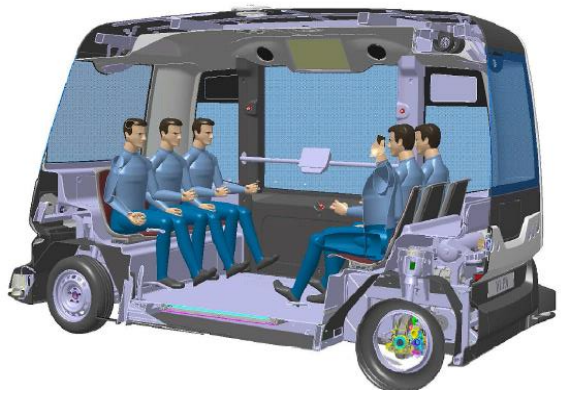
ibeo

Connekt

WEpods Gelderland NL

"The first selfdriving vehicles in the Netherlands will drive in Ede and Wageningen" Newspaper "de Gelderlander" 1 Oct 2014.

- Vision
  - 24/7 on demand "public" transport
  - Last mile (train to door)
- Innovation
  - From closed track to public roads



Driverless is a reality in the Netherlands

People since 1997

Driverless is a reality in the Netherlands

Rotterdam 1999 - 2002

Rotterdam since 2004

WEpods route

- Ede-Wageningen train station
  to Wageningen University (11 km)
  - Urban (other vehicles <30/50/60 km/h)
  - Diverse traffic: cars, pedestrians, cyclists
  - Traffic lights (1 extra)
- Testing
  - Steward on board (monitor, stop, intervene)
- Deployment
  - Control room monitoring

Technology

EASYMILE EZ10 platform

- Citymobil2

Additions

- D-GPS/RTK + INS + Odometry + landmark positioning
- 9 camera's + 9 radars + 8 ultrasonics
- 6 multilayer lasers
- NVIDIA Drive PX + ECUs
- Interior camera
- Interior + exterior intercom
- 4G LTE + Wifi-P 802.11p communication
- Electrobit E-Horizon
- 20 KWH batteries
- Heater, belts, roller chair fixation, wiper, 3rd brake light, int. covers, steward seat

- Supervisor system
- User App
- Infotainment

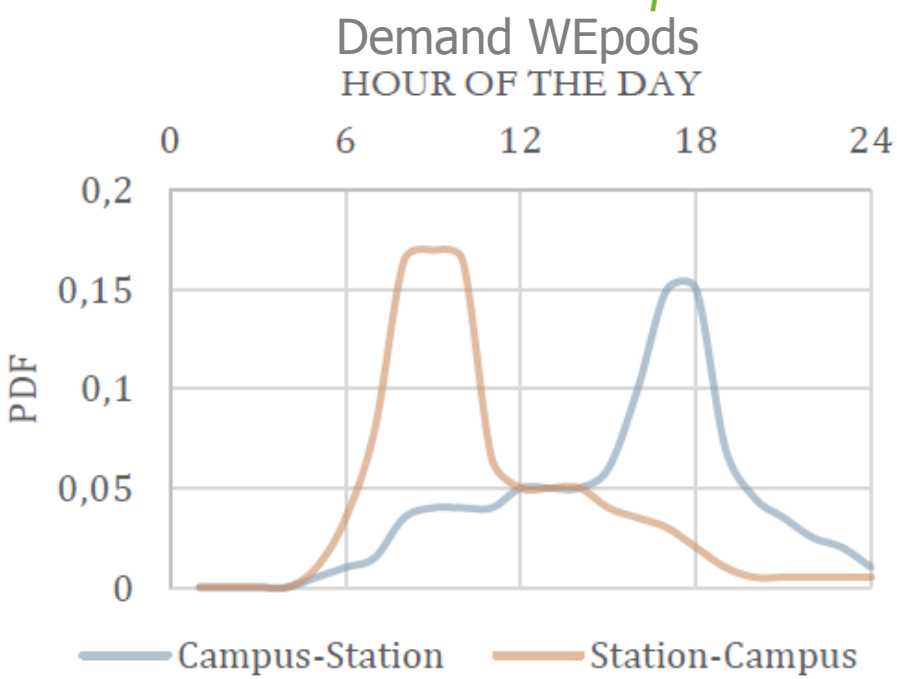
Wepods timeline

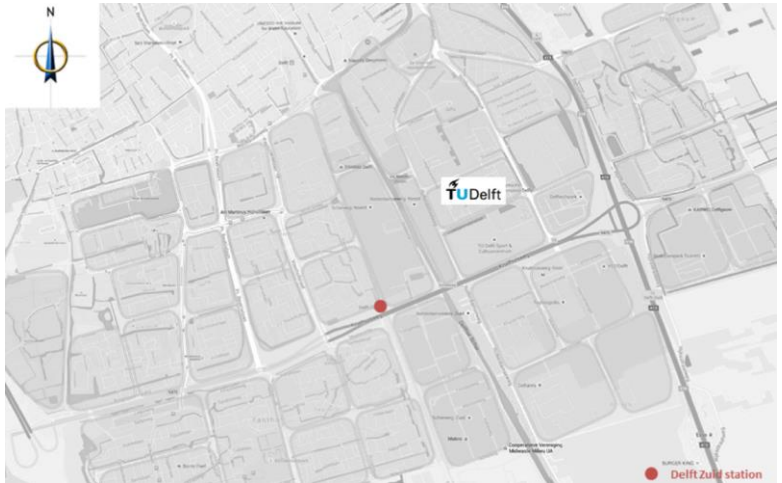
- January 2016
  - first licence plates driverless vehicle
  - first press event
- >May 2016
  - Testing & demos
- >Dec 2016
  - Driving every Tuesday 11-13hr
- Follow up projects
  - VRU detection & interaction
  - Affordability
  - Operational services

Towards functional use

- WEpods station Ede-Wageningen to Campus Wageningen University[1]
  - Optimum 280 vehicles, 5 Euro per trip

- Delft Zuid Last Mile[2]
  - Profit maximization leads to better service than serving first requests
  - 40 vehicles - 95% demand - optimal profit
  - 60 vehicles - 99.9% demand - 90% of optimal profit





1. Winter K., Cats O., Correia G. and van Arem B. 2015. Designing an automated demand-responsive transport system: fleet size and performance analysis for the case of a campus-train station service. Transportation Research Board meeting 2016.
2. Liang, Correia, van Arem Optimizing the service area and trip selection of an electric automated taxi system used for the last mile of train trips. TRPE 2016

Opinions on automated driving [1]

- Survey focused on cars[1]
  - Diverse / extreme responses
  - 22% unwilling to pay for fully automated driving
  - 5% willing to pay more than $ 30,000
- Survey focused on automated shuttles[2]
  - 57% would use a 100% electric driverless vehicle from the train station or some other public transport stop to the final destination or vice versa
  - 56% would use it 1 day per week or more
- Concerned about
  - software hacking/misuse
  - legal issues and safety

1. Kyriakidis, Happee, de Winter. Public opinion on automated driving: Results of an international questionnaire among 5,000 respondents. TRPF-2015.
2. Nordhoff, van Arem, Happee, Kyriakidis. Modelling Acceptance of Driverless Vehicles in Public Transport: Results of an International Survey with 10.000 Respondents. In preparation.

Outlook Driverless Transport

- Technology
  - Increase velocity
  - Reduce costs
  - Prove safety
  - Drive without steward
  - Legislation
- From demo to operation
  - Acceptance, occupants & other road users
  - Flexible Reservation