# AUTOMATION PILOTS ON PUBLIC ROADS IN THE NETHERLANDS

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TNO innovation for life

# PROJECTS

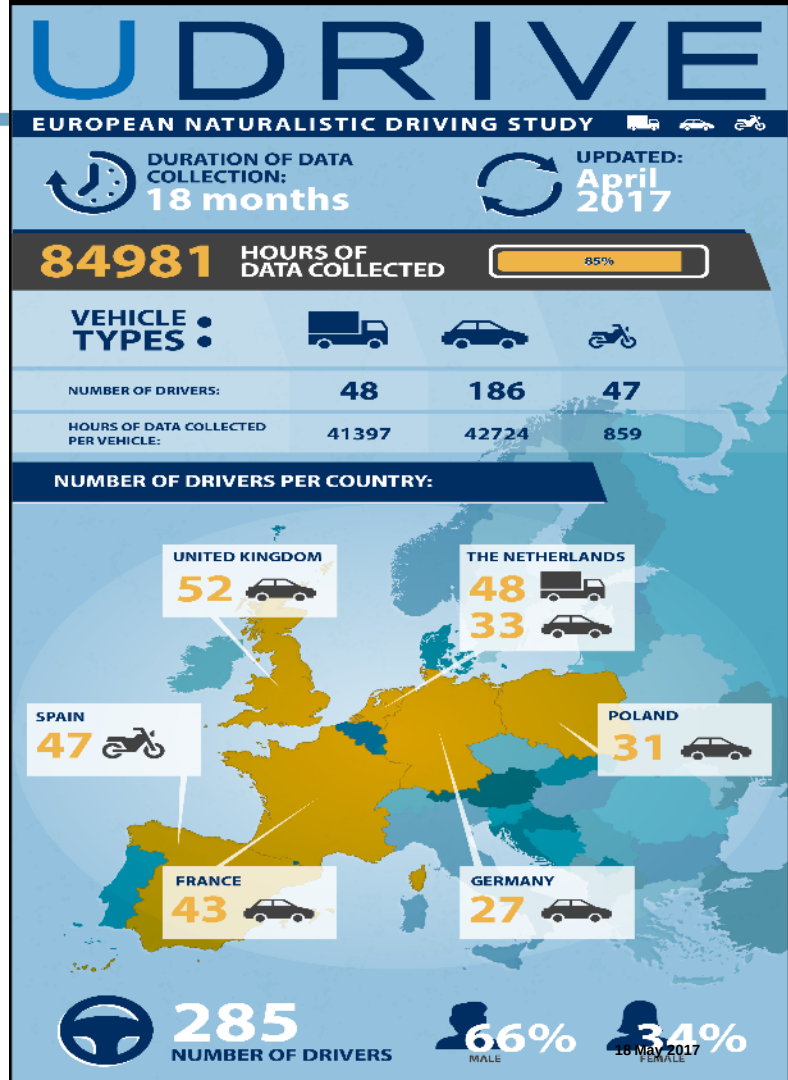
- **Udrive**: Large Scale Naturalistic Driving Observations in Europe
- **MRE Pre-automated Driving**: Real life scenarios for testing of Automated Driving
- **ENABLE-S3**: Valet parking pilot
- **EU project Autopilot**: Brainport pilot

# UDRIVE: FACTS AND FIGURES

| | |
|---|---|
| Programme: | 7th EU Framework Programme |
| Project type: | Collaborative project, large-scale integrating |
| Coordinator: | SWOV Institute for Road Safety Research (NL) |
| Consortium: | 19 partners, 10 countries |
| Duration: | October 2012 – July 2017 |
| Budget: | € 10.5 million |
| EU funding: | € 8 million |

UDRIVE
European Naturalistic Driving Study

SEVENTH FRAMEWORK PROGRAMME



# NATURALISTIC DRIVING DATA

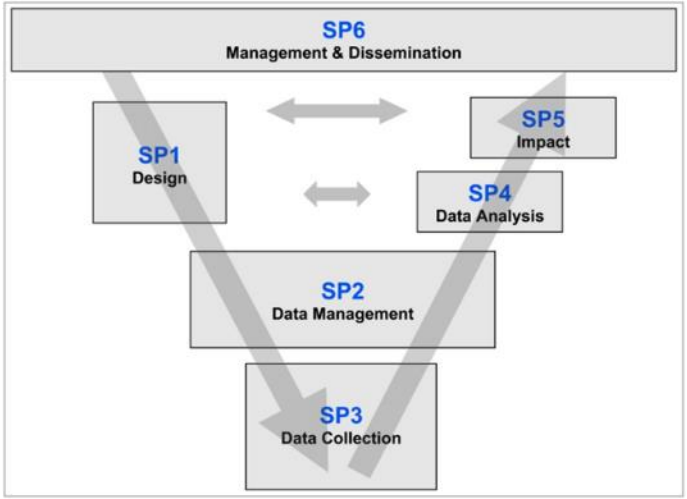
- Natural behaviour in natural surrounding
  - No experimental interventions
  - Insight look “over the shoulder” of the driver
- Allows to study exposure, prevalence and risk
- Direct observation of conflicts and (near) crashes
  - Exact and detailed information what preceded
  - No bias by post-hoc reporting

Laboratory study

Driving simulator study

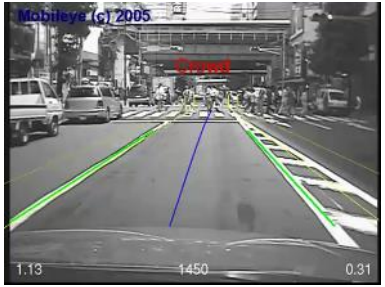
Instrumented car study

**The UDRIVE approach: based on FESTA-V**



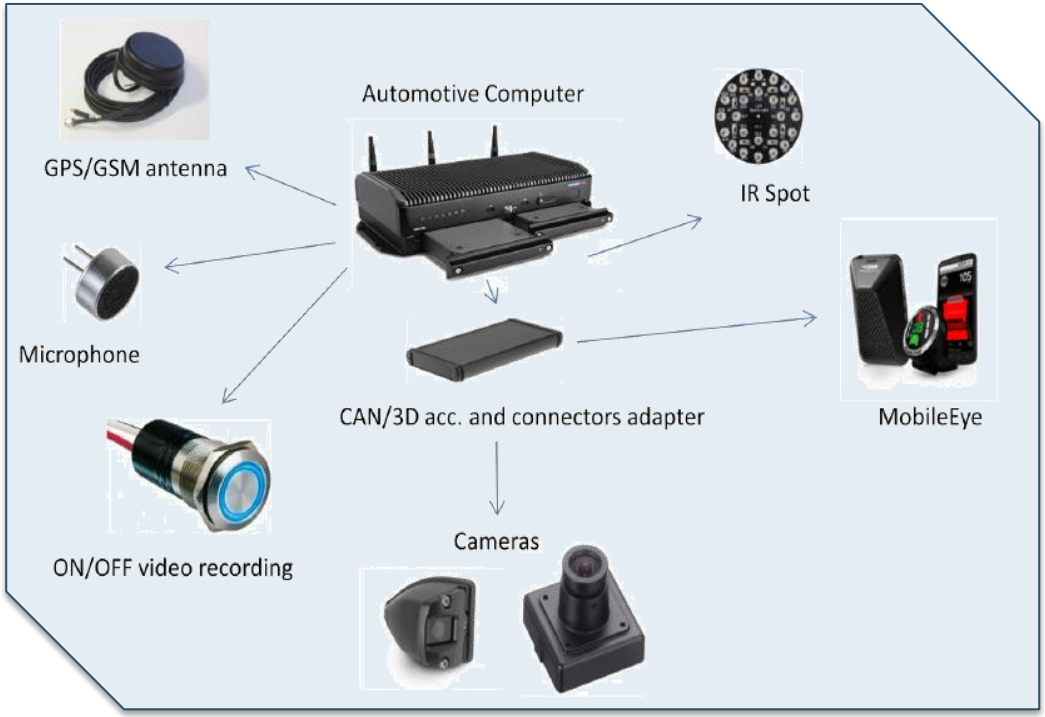
# MAIN RESEARCH AREAS AND ANALYSES

- Crash causation and risk
- Everyday driving
- Distraction and inattention
- Pedestrians and cyclists
- Motorcycle behaviour
- Eco-driving




- Pre-processing and data enrichment
- Preliminary Analyses Plan
- Safety Critical Events

# THE DATA ACQUISITION SYSTEM (DAS)




# CAMERAS

- Front view wide (3 cams)
- Face view (1 cam)
- Driver’s activity (1 cam)
- Driver’s feet (1 cam)
- Cabin view (1 cam)

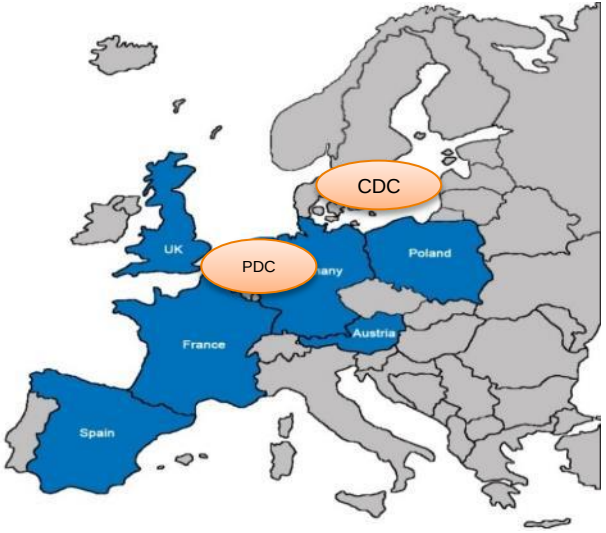

7 cameras

# ACCESS TO UDRIVE DATA

- Data available for post project research
- Data access for non-partners

- Analyses can be performed remotely on the dataset!

- Central Data Center (CDC)
  - Located at SAFER, hosts all data
  - A copy of the database will be available in NL

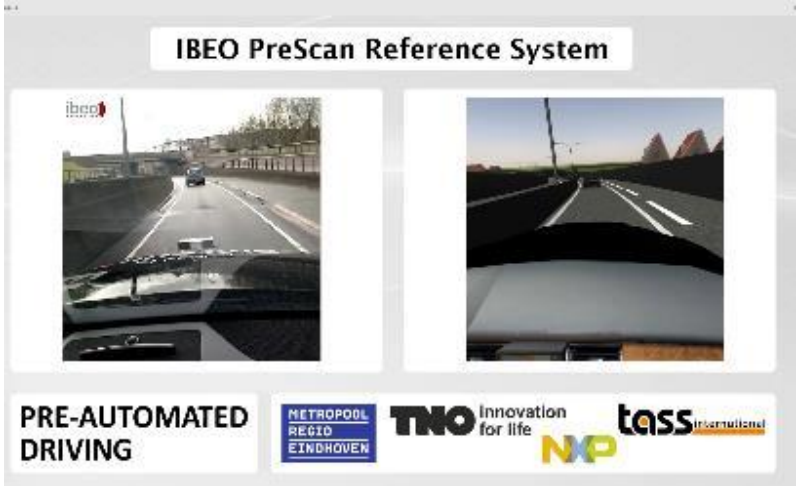


# UDRIVE FINAL EVENT COMING SOON


http://www.udrive.eu

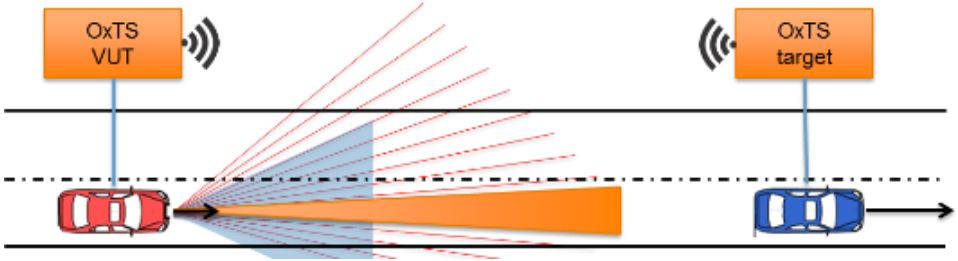
# PRE-AUTOMATED DRIVING

- Consortium: NXP, TNO, TASS International
- Sponsor: Metropole Eindhoven Region (MRE)
- Goals:
  - Collect real-life scenarios for testing Automated Driving functions
  - Collect data for system requirements of sensor systems
- Funding: 460 k€
- Duration: April 2015 – March 2017 (finished)



# TEST SETUP

- Interaction between vehicles in mixed traffic
  - 3 instrumented Toyota Prius vehicles, Mercedes C-class with NXP radar
  - Highway and rural platooning Helmond-Eindhoven A270
  - Duration: 2 days of naturalistic driving
  - Experienced drivers
  - Radar, lidar, video recordings and vehicle data




# CONCLUSIONS AND LESSONS LEARNED

- Real life scenarios provide valuable insights in addition to controlled environment tests
  - Enormous variability of manoeuvres
  - Real life requirements for sensor systems
- Bridges and tunnels provide major reflections that are challenging for radar processing
- Instrumentation of vehicles is never a routine job – careful attention and check-double check

# ENABLE-S3 VALET PARKING PILOT

- Validation of highly Automated Cyber Physical Systems
- Multiple application domains, including Automotive

- Project Budget: 68 Mio EUR
- Public Funding: 33 Mio EUR
- Duration: May 2016 – April 2019

- 71 Partners:
- **OEM:** AIRBUS DEFENCE, IXION AEROSPACE SL, PHILIPS MEDICAL SYSTEMS, RENAULT SAS, THALES ALENIA SPACE, THALES AUSTRIA, TOYOTA EUROPE
- **1st, 2nd, 3rd tier suppliers:** AVL SFR, Cavotec German, DENSO DE GmbH , EVIDENCE SRL, GMV AEROSPACE, GMVIS SKYSOFT SA, Hella Aglaia, IBM IRELAND, MAGNETI MARELLI, MICROELETRONICA MASER, MAGNA STEYR, Nabto ApS, NAVTOR AS, NXP GERMANY, ROHDE & SCHWARZ, REDEN B.V., serva transport, Tieto Finland Oy, TTControl, TTTECH, TWT, Valeo Autoklimatizace, VALEO SCHALTER UND SENSOREN GMBH
- **V&V environments:** AVL, AVL DE, BTC EMBEDDED, DSD.ATENTECHNIK, MAGILLEM, MDAL SARL, MODEL ENGINEERING SOLUTIONS, NM ROBOTIC, RUGGED TOOLIN OY, SIEMENS INDUSTRY SOFTWARE NV, VIRES SIMULATIONSTECHNOLOGIE GMBH

# USE CASE 1.5 VALET PARKING

- Use case leader: Denso Germany
- Goal: stable architecture for valet parking
- Goal of pilot:
  - Collect valet parking scenarios, in particular vehicle – pedestrian interactions
  - Characterise sensitivity of vehicle sensors for indoor environment of parking house

# VALET PARKING TEST

- Instrumented Toyota Prius vehicle
- Environment: ego vehicle, pedestrians, shopping carts
- Date: 22-23 March 2017, 5 hours of parking
- Location: Cities of Helmond and Eindhoven, IKEA, The Netherlands.
- Assumptions: No ADAS used while driving
- Equipment used: GPS, VBox, Busdaq, Radar, MobilEye, Lidar
- Context: naturalistic driving and parking with mixed traffic with unautomated cars and vulnerable road users and during rush hour and during quiet hours. Different light conditions.

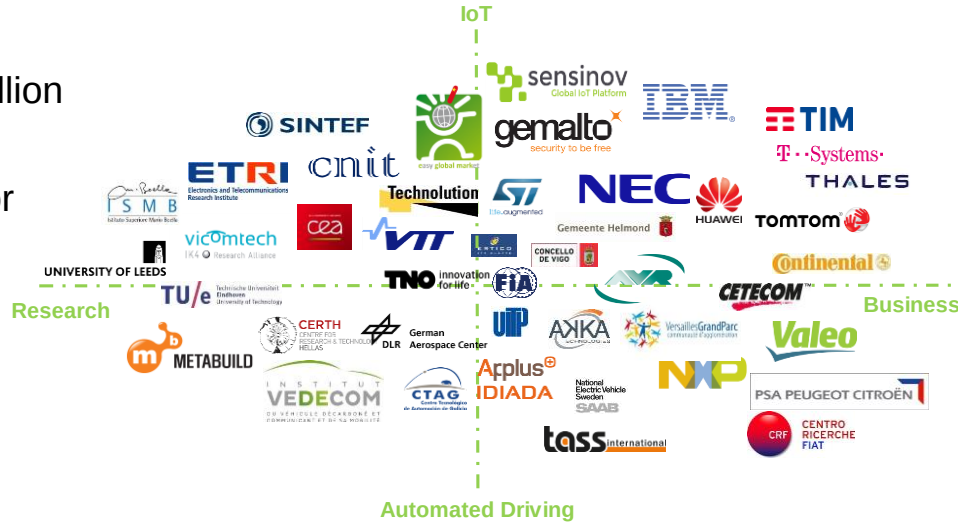
# CONCLUSIONS AND LESSONS LEARNED

- Real life test trips provide valuable insights in addition to controlled environment tests
  - Enormous variability of situations, e.g. forgotten shopping cart, greasy floor, ‘random’ pedestrian trajectories
  - Real life requirements for sensor systems, e.g. contrast, blinking TL light, radar reflections
- In car scenario annotation is valuable but produces motion sickness
- Instrumentation of vehicles is never a routine job –
  careful attention and check-double check, also during tests

# EU PROJECT AUTOPILOT: BRAINPORT PILOT

- Demonstrate added value of Internet of Things for Automated Driving
- Innovation Action - 3 Years: 01/01/2017 – 31/12/2019
- 44 beneficiaries – coordinator: ERTICO
- Project costs: €25 million - EU contribution: €20 million

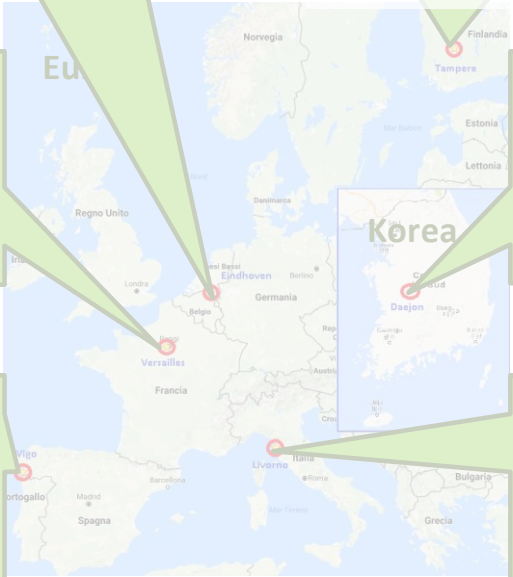
- Brainport region: IoT enabled Automated Driving for supporting Real-Time Car Sharing services



## Brainport, NL
- Automated Valet Parking
- Highway pilot
- Platooning

## Tampere, FI
- Automated Valet Parking
- Urban Driving

## Versailles, FR
- Automated Valet Parking
- Urban Driving
- Platooning



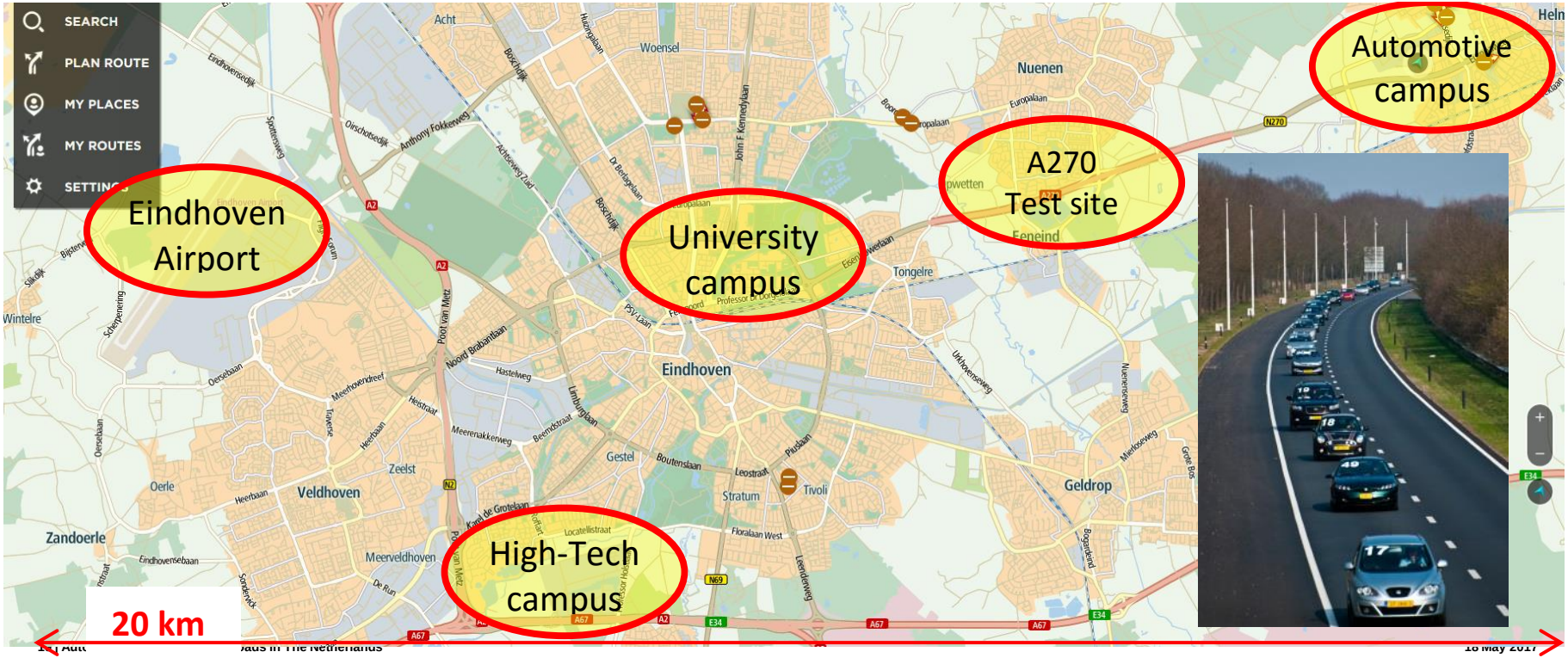

## Daejeon, KR
- Urban Driving

## Vigo, SP
- Urban Driving
- Automated Valet Parking

## Livorno, IT
- Urban Driving
- Highway pilot

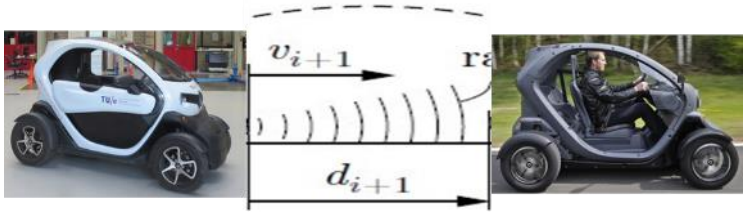
# 6 pilot sites

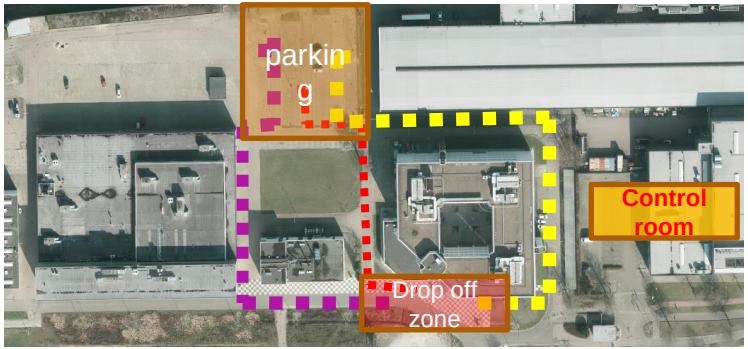
# FOUR MAIN HUBS FOR CAR SHARING AND IOT



# MAIN THEME OF BRAINPORT PILOT


- Real-time Car Sharing supported by Automated Driving
  - Vehicle on demand
  - Automated Driving for Mobility-as-a-Service
  - Storage and retrieval of vehicles
- Enabling use cases
  - Driverless car rebalancing
  - Platooning & Highway pilot with electronic lane allocation
  - Automated Valet Parking
- IoT for
  - Routing, scheduling and logistics of vehicles
  - Hybrid control via infrastructure and vehicle systems
  - Legacy traffic assessment
  - Use of emergency lane for Automated Driving



# FACILITIES OF THE BRAINPORT

- TASS Mobility Centre Control Room
- Extended coverage of C-ITS communication network and cellular
- Camera surveillance
- Traffic innovation Centre
- Road exemptions for Automated Driving experiments

# THANK YOU FOR YOUR ATTENTION

Take a look:
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