Universität Stuttgart
Institut für Ingenieurgeodäsie

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Role of Digital Maps in Road Transport Security

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TS07E: Multi-Sensor Positioning

FIG Working Week 2019

22-26 April 2019, Hanoi, Vietnam

Outline

- Motivation and Introduction
- Map Data Availability Analysis
- Map Data Quality Analysis
- Map Preview in Demonstration
- Outlook

Motivation

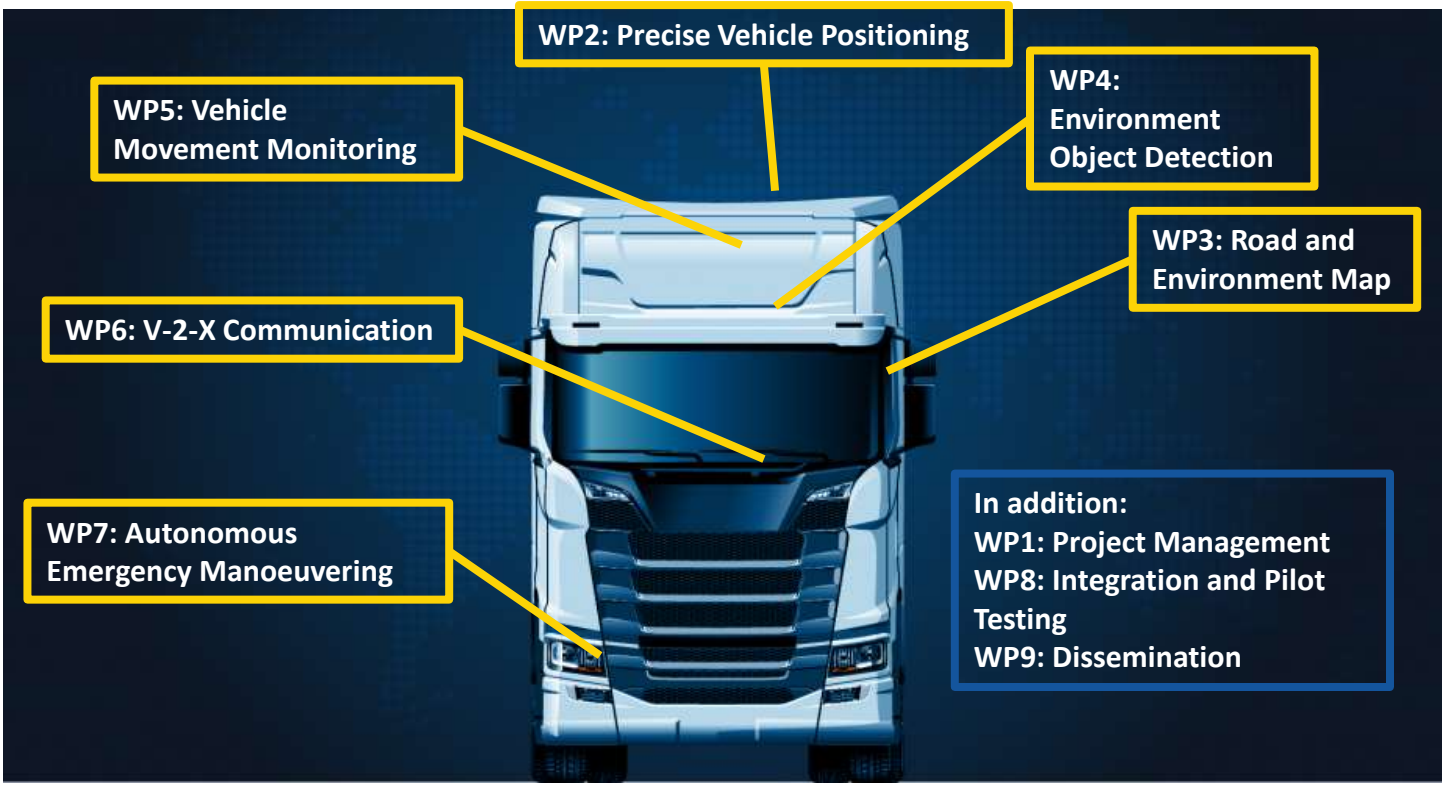
Source: https://www.berliner-zeitung.de/berlin/breitscheidplatz-entsetzen--trauer--verzweiflung-nach-der-tragoedie-25342214

Source: https://www.stuttgarter-zeitung.de/thema/Terroranschlag_Nizza

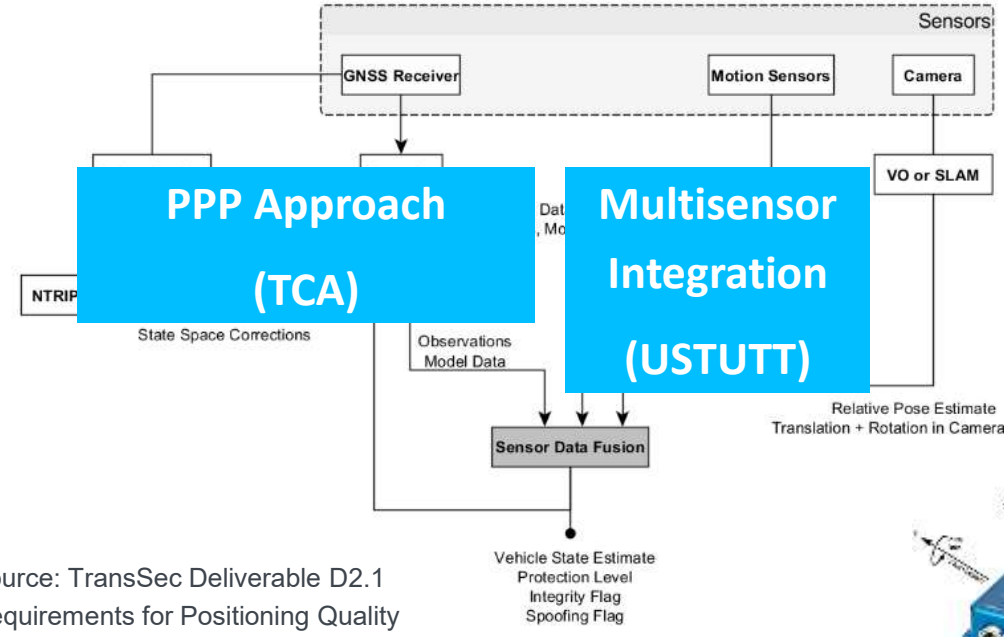
Autonomous Emergency Manoeuvring and Movement Monitoring for Road *Trans*port *Sec*urity ➔ TransSec

- Funded: GSA (European GNSS Agency) within the H2020-GALILEO-GSA
- Duration: February 2018 to February 2021 (3 years)
- Partners:
  - Daimler AG (DAI), Germany
  - TeleConsult Austria GmbH (TCA), Austria
  - Vicomtech (VICOM), Spain
  - Waterford Institute of Technology (WIT), Ireland
  - Institute of Engineering Geodesy, University of Stuttgart (USTUTT), Germany

Introduction
TransSec Project



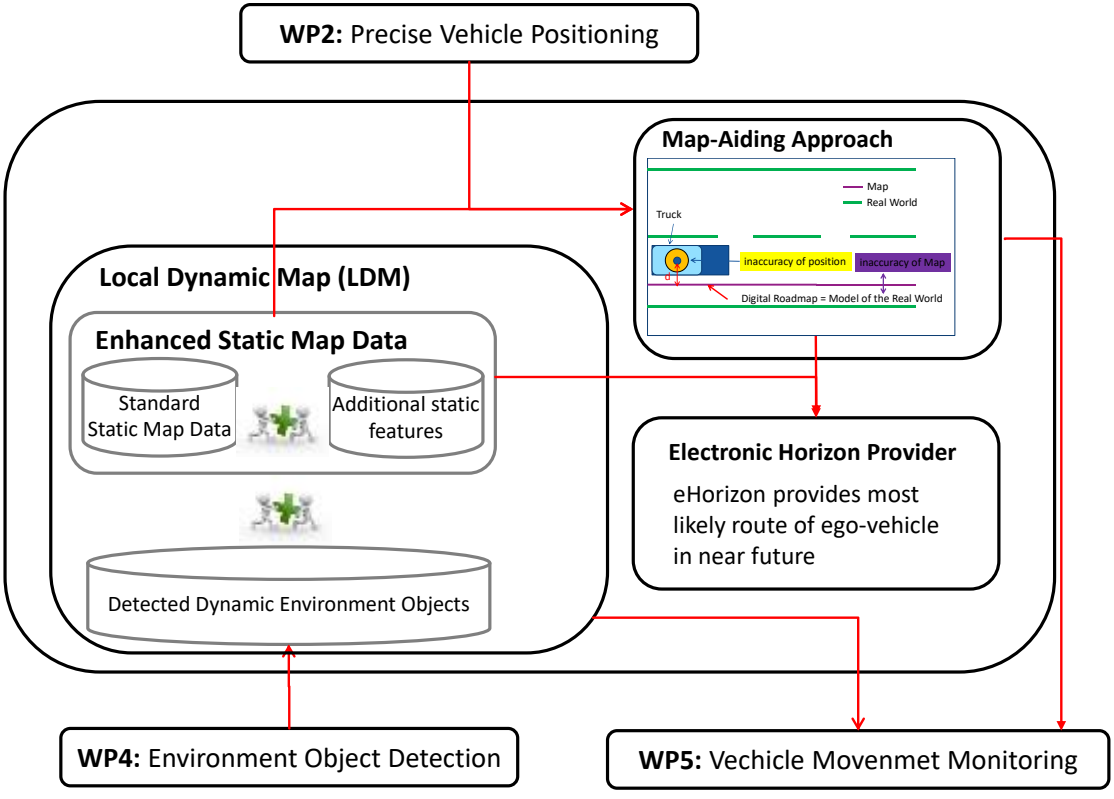
Introduction
Overview of WP2-Precise Vehicle Positioning



Source: TransSec Deliverable D2.1
Requirements for Positioning Quality

Image source:
https://www.vboxautomotive.co.uk/images/products/IMU04-with-xyz.jpg

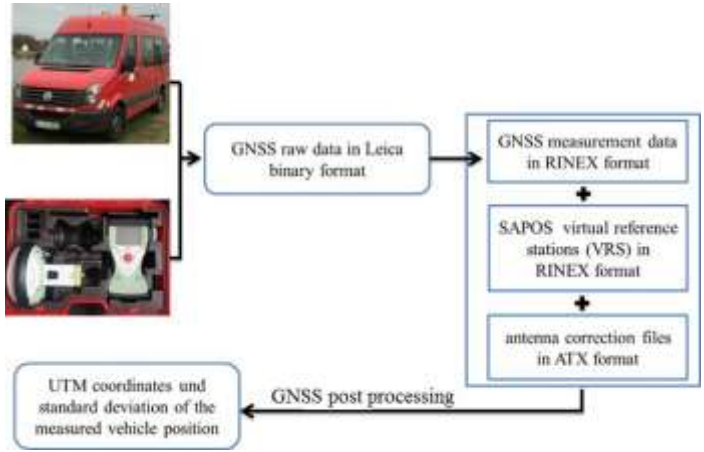
Introduction
Overview of WP3- Road and Environment Map



Map Data Availability Analysis

- NDS (Navigation Data Standard) Map
- NDS is worldwide map standard for automotive grade use. It is a standardized **binary** database format and enables the exchange of navigation data and flexible map update.
- Map Data Availability Analysis based on Use Cases. E.g. shopping street are as line feature and market places are as area feature available etc.
- Availability of standard attributes and truck-related attributes was investigated. E.g. attributes like direction of travel, speed limit, road access restriction and limitation in weight and/or dimensions for trucks are available.

Map Data Quality Analysis



Generation of reference Trajectories based on kinematic GNSS measurements

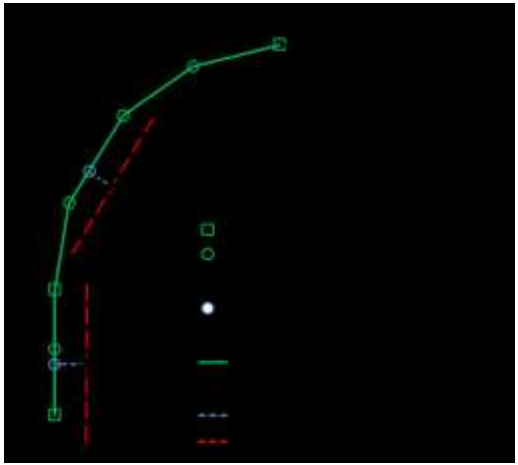
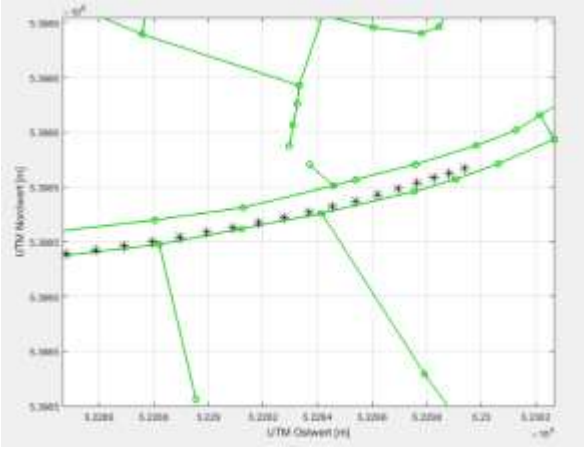
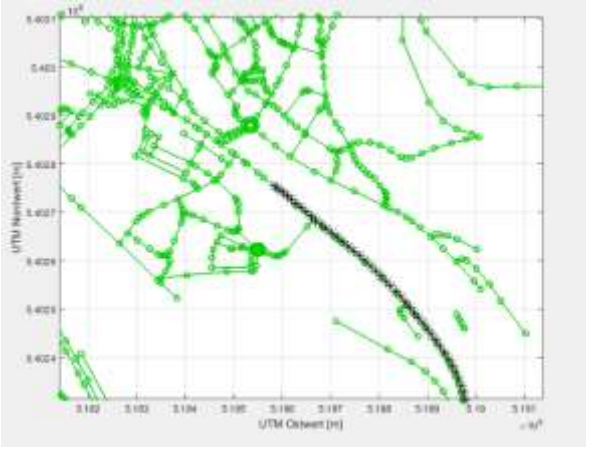


Illustration of the vehicle position relative to the road centreline (with consideration of number of lanes and lane width)

- Reference Trajectories: measurement from geodetic GNSS receiver
- Overall length of ca. 100 km, tested trajectories include **35 non-highway roads**, 43 highway entrance/exit ramps and part of one highway nearby Stuttgart.
- Absolute accuracies: about **1.51 m**, 1.45 m and 1.33 m
- Relative accuracies are **0.6 m**, 1 m and 0.3 m, respectively.

Map Preview in Demonstration





(a) high zoom factor

(b) low zoom factor

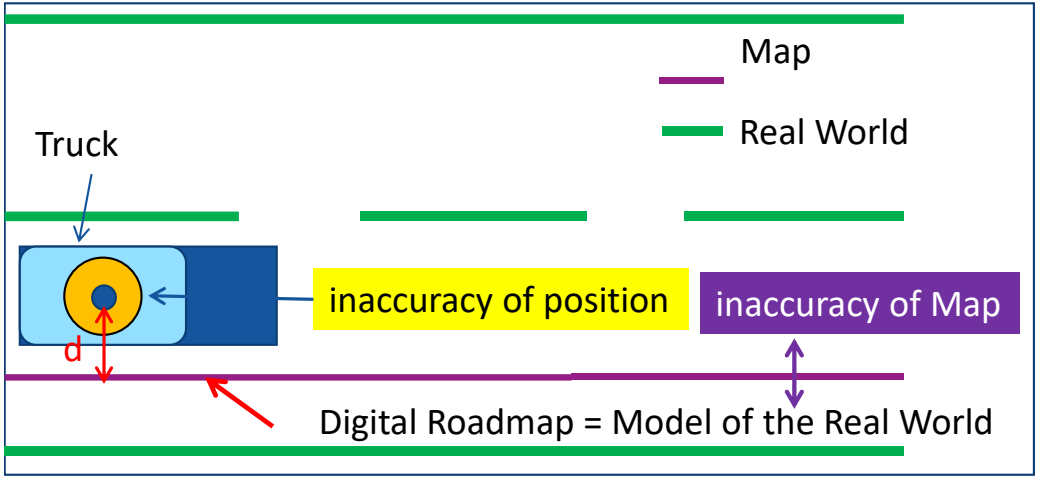
Source: TransSec Deliverable D2.2 Galileo Positioning System for Trucks

Outlook
Electronic Horizon Provider

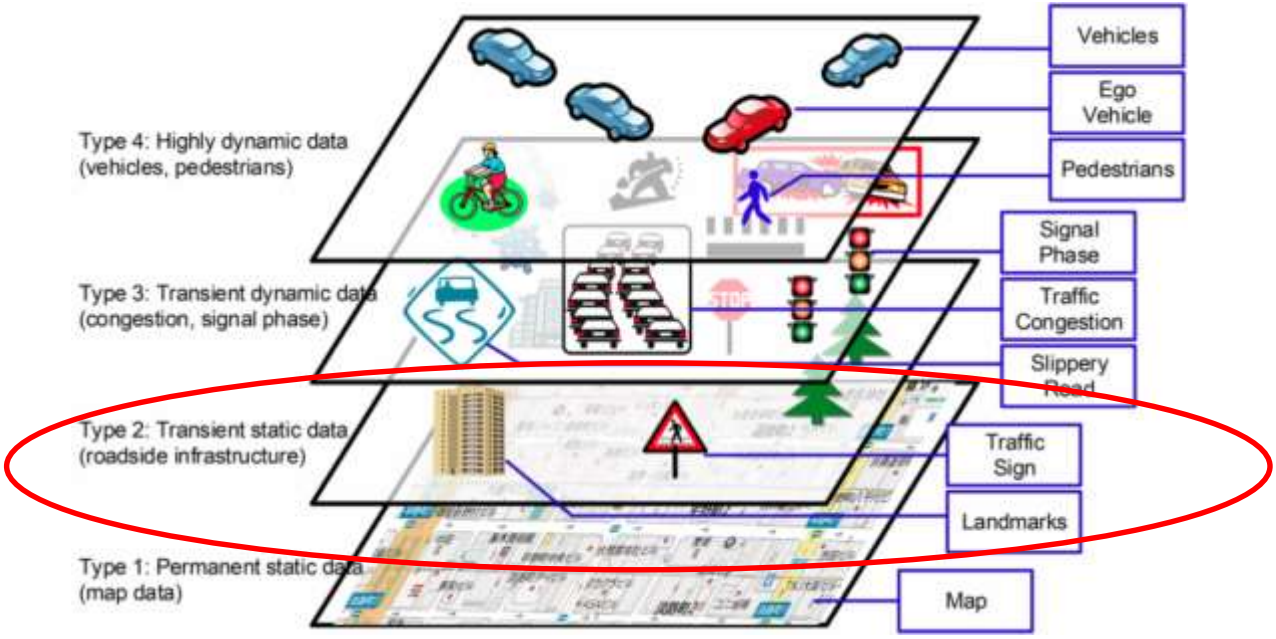
https://www.infoware.de/en/automotive/electronic-horizon/

Electronic Horizon provides **Most Probable Path** of ego-vehicle in near future

Map Aiding



Outlook
Local Dynamic Map (LDM)

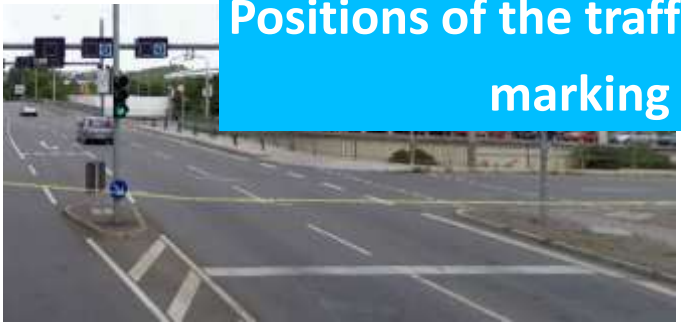


The layered architecture of the LDM (Source: Schimada et al., 2015, "Implementation and Evaluation of Local Dynamic Map in Safety Driving Systems". Journal of Transportation Technologies, 2015, 5, 102-112)

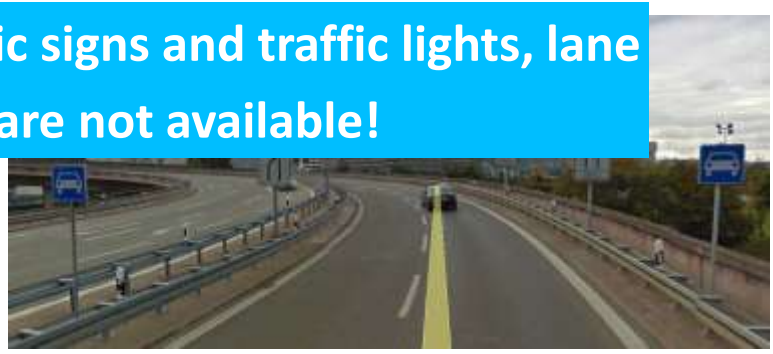
Outlook
Positions of traffic signs and traffic lights

Traffic signs (source: https://www.alamy.com/stock-photo/forest-of-traffic-signs.html)

Positions of the traffic signs and traffic lights, lane marking are not available!



Traffic lights (source: Google Earth Street View)



Traffic signs (source: Google Earth Street View)

Enhanced Static Map

Acknowledgement

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Thank you!
Vielen Dank!

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