



# UP-Drive

*Automated Urban  
Parking and Driving*

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
SEAM	Restricted to partners of the SEAM Cluster (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

**EXECUTIVE SUMMARY**

This document reports on UP-Drive mid-term demonstration which marks the successful completion of the 1<sup>st</sup> development and integration cycle. This document details the outline of the event. It discusses major results and organizational aspects. The target groups of this document are the European Commission and the partners of UP-Drive.

**CONTRIBUTING PARTNERS**

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## 1 Concept of the demonstration

The event was organized with particular attention to the integration of the complex UP-Drive architecture and the completion of the 1<sup>st</sup> development cycle. It was held in conjunction with the UP-Drive 2<sup>nd</sup> Technical Review (TR). Prior to the demonstrations the reviewers and the EC Project Officer were guided through a series of presentations aiming at explaining in details the current development and operation of the different components. Particular focus was on operation of the complete software stack, however the integration of the components and their interfaces were visualized at well. The key message was that UP-Dive is designed to deliver a fully integrated system able to perform automated driving in complex urban scenarios. After the demonstration, one hour Q&A session in relation to the car demonstration have been organized.

<b>Time</b>	<b>Topic</b>
08:30	Start of TR2 and mid-term demo: Welcome
08:45	WP1 – Requirements, System & Components Specification & Architecture
09:00	WP2 - Vehicle Infrastructure
09:20	WP3 – Cloud infrastructure
09:35	WP4 – Perception
10:20	<i>Coffee break</i>
10:30	WP5 – Lifelong Localization & Mapping
11:00	WP6 – Scenario Understanding
11:30	WP7 - Decision making and Navigation
11:50	Demonstration in the car
12:50	<i>Lunch</i>
13:35	Q&A in relation to the car-demonstration
13:55	WP8 – System Integration and Evaluation
14:15	<i>Coffee break</i>
14:25	WP9 – Dissemination, Exploitation & Knowledge Management
14:40	WP10 – Project Management
15:00	Reviewer meeting
16:00	Feedback for the consortium
17:00	End of TR2 and mid-term demo

## 2 Mid-term demo

The mid-term demo was held when UP-Drive project reached an essential milestone with the completion of the 1<sup>st</sup> development cycle. The event took place at the VW-Werk (factory facility) in Wolfsburg during the 2<sup>nd</sup> Technical Review on 25<sup>th</sup> September.

In approximately one hour demonstration, the reviewers and EC project officer experienced automated driving in urban environment having the possibility to follow the performance of the different modules on in-vehicle visualization monitors. The demonstration was performed along the A-B-A test route in VW-Werk as shown in *Figure 2-1*.



*Figure 2-1 Demonstration route*

The following functionalities have been shown:

- VisLoc and map alignment
- Car and pedestrian detection and classification based on the Supersensor
- Predication of pedestrians and objects based on a data driven approach
- Detection and visualization of parking spots and aggregation in the cloud
- Visualization of the motion planning stack

The demo consisted of a number of self-contained use case demonstrations that has been shown to work independently from each other.

### *UC1: Data management*

1. Acquisition of mission data
2. Upload and storage of missions / mission data, automated indexing
3. Query for specific mission data (based on recording time, size, etc.)

### *UC2: Semantic data querying*

1. Acquisition of mission data

2. Extraction of semantic data, in particular parking spots (and their occupancy state) with a link to the recorded frame / timestamp, as well as a bounding box in Visloc frame
3. Upload and storage of mission data, as well as semantic data linked to mission data
4. Processing of semantic data: conversion of coordinates into UTM coordinates
5. Processing of semantic data: association / clustering of semantic data onto known parking spots that form part of the DLM map
6. Query for parking spots in a geographic vicinity (in UTM frame) as well as the occupancy statistics of each of the returned spots
7. Initialization of mission planner with target location based on queried parking spaces

#### *UC3: Automated driving with focus VisLoc*

1. Online metric visual localization and mapping
  - Real time and under different lighting, weather and seasonal conditions
2. Map maintenance and summarization
  - Structural changes and data trustworthiness
  - Map summarization
  - Cloud map representation and storage
3. Semantic information integration
  - Map is the backbone for tight integration with results from WP4 and WP6

#### *UC4: Static supersensor demo*

1. Algorithms adapted to the new car configuration – works adaptively with 16-/32-layer LIDAR
2. 3D obstacle detection improved by detection orientation (L-fitting based on RANSAC)
3. Road surface detection
  - Road and obstacle separation in cylindrical layer
  - Predominant planar road patch selection
  - Patch transformation into a Cartesian representation using Bresenham interpolation
  - Fuse the five Cartesian road patches from each LIDAR
  - Compute an estimate of the road elevation in each grid location
  - Compute an area of uncertainty
4. Obstacle detection
  - Build a voxel representation (70m x 20m x 4m)
  - Cluster the voxel space

#### *UC5: Manual driving with focus parking spot detection*

1. Parking Spot Occupancy

- Given a region at time  $t$ , determine its occupancy state
  - Principle: occupancy map aggregation, dynamic posterior decision
2. Low-level geometric background map
- Aggregate detailed low-level geometric map from repeated drives and detect changes
  - Sub-tasks:
    - Register and fuse static part of scene from LiDAR data
    - Detect new objects in current frame
    - Group detections, possibly classify them

For data protection purposes (EU GDPR regulations), no pictures were taken during the event. For illustration purposes, the demonstration vehicle is shown in *Figure 2-2*.



*Figure 2-2 UP-Drive demonstration vehicle*

### 3 Conclusions

The UP-Drive mid-term demonstration was successfully held at the VW-Werk (factory facility) in Wolfsburg, thus marking the successful completion of the 1<sup>st</sup> development and integration cycle. The partners are committed to further develop the systems in order to deliver a fully integrated system able to perform convincing demonstrations on public roads. UP-Drive project plans to arrange a public demonstration as part of the final event of the project in M48. It will be organized in coordination with the communications departments of all partners. The demonstration will take place in a real urban setting within a 30km/h zone. The event will showcase the aims of the project, the scientific achievements, and the market potential of the developed technology.