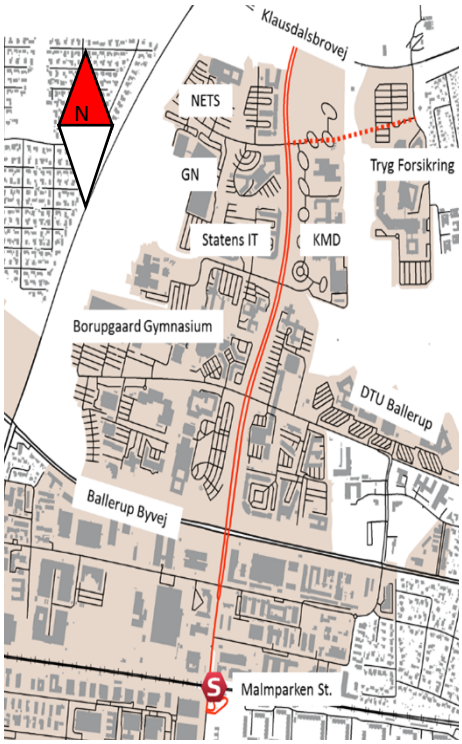
1. Demo site map and key characteristics

The testsite Lautrupgaard is located 15 km Northwest of Copenhagen in the municipality of Ballerup. Lautrupgaard is often mentioned as the *Danish Silicon Valley* due to its concentration of ambitious TECH businesses and skilled IT/knowledge specialists in combination with The Technical University of Denmark (DTU) and a local high school with strong technology profile with a total of 3.500 students. A masterplan outlines the ambitions of growing the 250 hectares (2.5 km²) business area from its present 20.000 workplaces by 25% by 2030. The testsite will allow for a demonstration of a full-scale high capacity feeder service, in full cooperation with the existing Public Transport service, using a upcoming Bus Rapid Transit (BRT) infrastructure linking efficiently to the nearby multi-modal Public Transport Hub (S-train, high-speed busses, local busses and shared e-bikes).



The test is in full alignment with the environmental goals and initiatives outlines in the SUMP and SULP for Greater Copenhagen. Further, Danish legislation is in place for test of autonomous vehicles at SAE level 4.

2. Current and emerging infrastructure and vehicles

Currently a BRT project is investigated with a view to build 2 km of BRT infrastructure along the vertical red route to pave the way for a full-scale autonomous BRT to be put into regular service by 2023/2024. A full scheme of Bus Transport signal Priority will be in place by the end of 2019.
The services to be developed and tested in this demo will set new standards on a European scale for meeting user needs for integrated autonomous shared mobility in an open road environment with heavy peak traffic, and in a demand-based approach. 3 shuttles (10 passengers) and 2 midsize autonomous busses (25 passengers) will provide a combination of first/last mile service during the day and door-to-train service outside rush hour and as an much asked after evening service.

3. Existing Public Transport infrastructure & Mobility Operators

The Business area is serviced by 18 hourly S-train (local railway) departures (rushhour), as well as a bus-departure every 6 minutes (direction Lautrupgaard). With 4.000 daily commuters using the bus service a total of 15% of the commuters to the business area travel by Public Transport. This number is estimated to increase to 25% by providing autonomous door-to-bus/train service.
Further, a number of new mobility services (NMS) already operate in the demo site area: Donkey Republic, a bikesharing operator; Drive Now, Free floating carsharing. All Public Transport and all NMS services will be available at the national multimodal TravelPlanner, MinRejseplan.

4. C-ITS infrastructure

Currently, the demo site area is not equipped with C-ITS infrastructure or traffic control center. The road signals will be prepared to communicate with the autonomous buses as part of the test.

5. Connected previous and current projects/initiatives/etc.

Copenhagen Commute will build on three ongoing test of autonomous busses around Copenhagen: The LINC project testing three EZ10 buses at DTU Campus and in a business area, funded by EU Urban Innovation Action (http://lincproject.dk/en/om/). The AVENUE project, testing four Navya Arma buses for 2 years at a residential area, funded by EU H2020. And the “Hospital test project” running for a total of 18 months with one to two Navya Arma buses, funded by Movia.

6. Local community

The test site leader will be PTA Movia experienced in planning and executing test of autonomous busses (incl tendering, evaluation and development of on demand software), in cooperation with The Technical University of Denmark (DTU) with knowledge of demand prediction software and other ITC solutions. Pending political decision, the third partner will be The Municipality of Ballerup, providing the responsibility for the roads and development and a close link to the local business network.

7. Objectives and Use Cases

The Copenhagen Commute test site will provide a unique possibility to test autonomous busses in a setting that will closely resemble the coming 5-10 years: Autonomous mobility closely integrated with "regular" Public Transport and new NMS providing a new affordable level of service also in the "thin hours" as night time. And a future where various operators need to coordinate, to provide a common service for the public.

Use case 1, Integrated automated PT with automated regular PT: The small and medium-sized buses will operate in SAE level 4 (no operator on board) as an integral part of the existing PT bus service. The objective is to replace at least one regular bus per hour during the demo period.
Use case 5, Self-learning DRT: The participating AV buses will shift between route and DRT mode according to time of the day and demand. The objective is to demonstrate the intelligent, real-time planning and dispatching of the AV buses combined with real-time information to passengers.
Use case 7, Interface to TMC: All buses will be connected to critical infrastructure i.e. road signals. The objective is to be able to monitor and re-direct AV busses in the demo site area according to actual traffic flows.
Use case 8, Energy applications: The operator-neutral intelligent planning and dispatching of vehicles in DRT mode will optimize energy and take into account the optimal charging pattern. The objective is to demonstrate efficient and energy-optimized traffic flows.

8. Users

The main focus is commuters, both for jobs and education/academia. However, the demo site will have also elderly, young, children, VRU, PRM and PTW.

9. Development plan and deliverables

The BRT infrastructure will be constructed in 2021 provided local political acceptance in 2020. Vehicles will be deployed at SAE level 3 and 4 (TRL 7). Passenger ordering of bus (app) will be developed (TRL6-7). Operator neutral control center will be developed (TRL6-7). Contracting of bus services in 2020. Initial testing and setup in 2021. Mobilization and operation in 2022-23. Evaluation will take place along the whole project period to be reported in 2023.

10. Sustainability plans

The driverless BRT at Lautrupgaard is a project aiming at achieving normal operation in 2025 where the automated services should be an integral part of regular PT. The funding from the state will be secured in batches pending local (Ballerup municipality) and national (Ministry) political acceptance. A budget of 2,4 mio. EUR has been reserved as direct support for the driverless BRT operation in the demo site area during the first years of operation (2022-24).

11. Business models

Movia is currently working on the customer aspect of on-demand-services and how new services can be incorporated in MaaS like systems. Emerging business models are expected for DRT as this service is currently not covered by regular PT. New business models are expected in the following relations: PTA and PTO (B2B) with special focus on how to make room for an operator-neutral control center; PTO and NMS operators (B2B) (MaaS like conditions); PTA and customer (B2C).