Mobilizing an Urban District with Driverless Busses

Aalborg Municipality has, as the first in Denmark, submitted an official application to the national Road Directorate for the use of driverless busses. The driverless busses are intended to increase mobility with self-driving technology on a pathway in Aalborg East, allowing more people to get around in an easy, safe and sustainable manner. The project is supported by both the local community and by the business network, and has many stakeholders.

A large transformation process with comprehensive housing renovations and new constructions.

Today, most public transport in Aalborg East moves on an east-west axis, which makes a north-south movement internally in the area impossible with this type of transportation. Thus, the less mobile population groups can be excluded from activities even close to their homes and can generally become highly segregated.

The separated infrastructure and the distance between the different functions and activities in the district do not encourage multimodal transport, and cars are used for a large part of the trips. However, less than 50% of the residents of Aalborg East have access to a car.

By implementing this driverless bus, increased accessibility aims to help mobilize a number of citizens, as well as enhance both environmental and social sustainability. The project supports the ambition of creating a more cohesive Aalborg East, where increased mobility is counteracting segregation and strengthening social capital. Access possibilities for wheelchairs etc., as well as the fact that the bus will be free of charge, makes the bus an ideal transport option for children, elderly, pedestrians,

Figure 1: Astrupstien (photo: Ditte Bendix Lanng).
wheelchair users and other groups with low car accessibility and mobility.

At the same time, Aalborg East - being the first to implement driverless vehicles in a Danish context - will make the district a first mover on driverless vehicles, using innovative technology as a mean to boost the image of Aalborg East. This is intended to create a positive attention and publicity about the neighbourhood, which in some contexts is associated with insecurity and other social challenges.

The pathway as a new spine for public transport
The Astrupsti connection is today the central connection for north-south movement for cyclists and pedestrians and it can act as the possible missing link between the northern and southern part of Aalborg East for public transport. However, it is not economically viable to implement a standard bus solution on Astrupstien, and therefore this project investigates whether a driverless bus without the cost of chauffeurs is an option that can have several other positive effects.

The test route
As a test route, the pathway from Lejerbo’s apartments at Skallerupvej and Jerupstien in the north to the southern part of the pathway at Tornhøjskolen and the newly opened dementia care centre is used. The length of the test route is approx. 2.1 km and there are 10 stops on the route where passengers can get on or off.

On the test route, the busses will be driving on Astrupstien and on Jerupstien on a bus and bicycle track. Both pathways combined are today approx. 6 meters wide along the entire route, where a grass verge divides pedestrians and cyclists. In order to accommodate the busses on Astrupstien, the pathway is expanded from today’s approx. 6 meters to a divided track totalling 6-10 meters.

The busses will be able to pass each other in the bus and bicycle track, but not in the tunnel under Smedegårdsvej and immediately north of this as an expansion of the track is not possible in these areas.

Timing and Legislation
The Danish Parliament passed a change of the Danish Traffic Act that came into force July 1st 2017 allowing for testing of driverless vehicles on SAE-level 3 and 4. A project can apply for a permission for testing driverless vehicles for a maximum of 2 years (with a possibility to re-apply for two more years) on a predefined geographical area. This is the period that is applied for in this project.

The application for this project was sent in the beginning of July 2018, and now follows 3-4 months expected processing time before the test will start in late fall 2018.

Passengers should perceive the bus as safe to use, as there will be an operator or a safety guard present for a start-up period, ensuring a safe ride and providing information to the passengers. Likewise, the busses will act as a safe element in the district, as it will create more life along the pathway.

When the project is fully implemented, it will be driving on SAE-Level 4 without an operator on board. Instead, it will be remotely monitored.

The driverless bus, ARMA
The test route will be serviced with NAVYA ARMA busses, with room for 11 seated passengers. Three electric buses are used, two of which will be in operation at a time while the third will be charging. The busses are designed to drive on a predetermined route and thus not with input from a map or on unplanned areas and roads.

Basically, the bus is built over the principle: If there is anything that it cannot figure out - then it stops.

When the implementation is final, it is expected that the bus will drive with a maximum speed of 23 km/h.

The busses are equipped with a multisensory technology, where the sensors are able to communicate and compare their data to optimize the bus’s decision-making:

- LIDAR sensors: 3D perception. The lidar draws a virtual image of its surroundings and it maps the environment allowing for precise positioning and ensuring that obstacles are detected.
GPS RTK: RTK is a communication between a GPS sensor and a fixed motionless base station on the ground that determines the exact position of the vehicle, which allows navigation with centimetre accuracy.

Odometry: Mechanical measurement of vehicle movement and wheel speed, to determine vehicle speed and confirm its position.

Camera stereovision: Detects obstacles and estimate their position relative to the vehicle.

**Evaluation and research**

The project will contribute with knowledge about how a driverless bus can become part of an existing urban area. For this reason, Aalborg Municipality has established a collaboration to evaluate the trial with Aalborg University and Nordjyllands Trafikselskab (NT). One part of the evaluation deals with the operation, conducted by NT, while the other part primarily will include qualitative evaluations of the integration of city, people and technology. This part is conducted by the Centre for Mobility and Urban Studies (C-MUS) from Aalborg University.

The evaluation conducted by C-MUS aims to create knowledge about the effects of the implementation of the driverless bus. This will examine how the new infrastructure and technology will integrate with the existing urban district, e.g., its physical character and urban life, including how it will be part of everyday life, i.e. how citizens and users will perceive and use the new infrastructure and technology, whether they can decode it and how it is used.

As knowledge about the effects of the new infrastructure is collected, the project will contain a special focus on evaluating sense of security and ownership. Firstly, on users’ and citizens’ sense of security in the district in relation to the driverless bus, as well as their perception of new situations that arise in and around the bus itself, which are relevant to safety. Secondly, on how public ownership of the bus is perceived and created; the extent to which different user groups accept the new infrastructure and technology and their perception of it as a new addition to the service to the local area and everyday life.

**Nordjyllands Trafikselskab (NT)** will conduct an evaluation of operations. This includes documentation and data collection about bus driving, 'uptime', timeliness and other events that may occur. This will be supplemented by counting of passengers, cyclists and pedestrians, as well as examination of how the bus is used.

**The “bigger picture”: new technology in planning**

Though the scope, the purpose and the setting for this trial project is focused and limited, the project is carried out to gain experiences and learning points for further navigation in ‘the bigger picture’ of a driverless future. Hence, the knowledge created in this project will contribute to answering some of the big questions that awaits future decisions on self-driving technology:

- Safety and security – How are the sense of security affected by the bus and the pathway in the area? Can the new technology be used as a reassuring action?
- Which effects does the technology have on the physical surroundings? Which effects can driverless technology have on existing urban districts, and to what extent will it change the design of future cities?
- How reliable is the technology? Who uses it and what is it used for? How can this technology help mitigate other problems in the future? How can this project be scaled to other contexts and geographies?
- "Connecting people with technology" – What happens in the meeting between humans and driverless technology? How does this affect future society, and how will local communities perceive it and, perhaps, want to adapt to it?

In these years, self-driving vehicles is only a small part of technological development that affects our society and mobility. If we are to decide what kind of cities and mobility we aim for in the future and if we want to expand citizens’ possibilities to carry out sustainable mobility (both social, ecological and economical), we need to gain experiences now on how to build future mobility planning. Perhaps this project is can help answering the question of how we can embrace technology in city and traffic planning and make informed decisions when we plan our future cities.

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*Figure 4: The Navya ARMA bus.*