Automated city shuttle: Let's have a ride in Europe streets!

Would you like to take a ride within an Automated City Shuttle (ACS)? if yes, which of the 118 demonstration site in Europe you would choose?

Today, with the multiple European initiatives, ACS projects have been in test or pilot phase over 17 countries where France, Germany and Norway have been classified as leading countries in terms of number of pilots [1]. Switzerland is the most advanced country regarding the integration of such mini-buses to the public transportation systems [2].

Those European cities have been acquiring the ACS to enhance citizen's quality of life by offering shared mobility services with higher efficiency and reliability at lowest costs [3]. Their key motivation is to propose an innovative public transportation through customised offers like on-demand and door-to-door services with more accessibility to elderly, children and disabled users [4]. Though, such new transportation paradigm needs to be approved by local authorities, adapted to real-life traffic conditions, tolerated by other road users and accepted by their eventual passengers. As a matter of fact, many pilots have popped up around Europe, drawing interest of university researchers, public transportation operators and private companies to assess the advantages and limitations of such smart mini-buses.

An overview of the key European projects would provide valuable insight on the integration of such mini-buses to the public transportation system. Table 1 depicts the major funded projects revisiting the offered public transportation services through ACSs. Such projects' motivation varies from studying the passenger experience to road user interactions like in Autobus [5] and Digibus Austria [6] projects. They aim also to assess the ACSs' social, economic, environmental and legal impact like in AVENUE [7] and SPACE [8]. Others, like CityMobile2 [9], focused on long term impacts in addition to the safety and legal certification of the ACSs.

Despite the project stage and accomplishments, the pilots aim to blend the traditional public transport system with novel urban mobility. The listed projects have been demonstrating shuttles with level 3 and 4 of automation according to the Society of Automotive Engineering (SAE) classification [10]. In other words, they have been testing mini-buses operating on high self-driving mode with the presence of an operator. Additionally, EasyMile EZ10 [11] and Navya Arma [12] (also called "Autonom Shuttle Evo") are widely used for European pilots as illustrated on Table 1. Actually, the first tested automated mini-bus in Europe was called the ParkShuttle in Netherlands which has been upgraded to reach a third generation model [13]. Further products have been tested but on smaller scale such as Olli [14] and Robosoft Robucity [15].

Per the listed projects' findings and publications, the ACS final deployment would depend on the vehicle speed upgrade and more testing on realistic traffic conditions. Being limited to a speed of 25km/h, the shuttle velocity can be slower than the cyclists' speed which may impact the transportation mode adaptation [1]. In addition, the vehicle abrupt breaking should be reduced as it represents another hindrance influencing the travel experience and hence the ACS full integration to public transport systems. Moreover, some sites have been operating under optimal conditions either by testing the vehicle in rural areas or in low to medium demand ares which won't reflect the vehicle behavior within a high traffic circumstances [16]. Furthermore, the cities readiness and the transportation systems should be coping with the fast approaching deployment of the ACS. The mini-buses functioning would depend on smart infrastructure equipment supporting secure vehicle communication with its external environment and with the different public transport interfaces [17].

To mitigate the vehicle limitations and the project risks, it is noteworthy to mention that the ACS pilots have a great support from coordination projects to upgrade the whole automated driving ecosystem. Aligning Research and Innovation for Connected and Automated Driving in Europe (ARCADE) [18] is a coordinate project supporting the different automated driving stakeholders through common research and lesson learned approach on regulations, standards, gap analysis and recommendations. Within Shared Personalised Automated Connected vEhicles (SPACE), a unique high level reference architecture has been built to integrate ACSs into the public transport network. Besides, Spatial and Transport Impacts of Automated Driving (STAD) [19] is a joint research project studying long term scale impacts of more advanced levels of automated driving to provide more accurate planning and transportation investments.

With the increasing Artificial Intelligence technologies, the deployment of 5G, the strong

Table 1: Major Automated City Shuttles Projects in Europe

Projects	Pilots	Funded By	Duration	Status	Vehicle
Autobus [5]	Three locations in Oslo: Forus Kongsberg Akershusstranda	Norwegian Research Council	2018–2022	Running	EasyMile EZ10 Navya Arma
AVENUE [7]	Geneva (Switzerland) Lyon (France) Copenhagen (Denmark) Luxembourg (Luxembourg)	Horizon2020	2018–2022	Running	Navya Arma
CityMobile2 [9]	Vantaa (Finland) Sofia Antipolis (France) La Rochelle (France) Trikala (Greece) Oristano (Italy) San Sebastian (Spain) Stockholm (Sweeden) Lausanne (Swizerland)	Horizon2020	2012–2016	Ended	EasyMile EZ10 Robosoft Robucity
Digibus Austria [6]	Koppl Wiener Neustad Teesdorf Salsburg	Future Mobility	2018–2021	Ended	Navya Arma EasyMile EZ10
FABULOS [17]	Gjesdal (Norway) Helsinki (Finland) Tallinn (Estonia) Lamia (Greece) Helond (Netherlands)	Horizon2020	2018–2021	Ended	Navya Arma
SOHJOA [20]	Kongsberg (Norway) Helsinki (Finland) Tampere (Finland) Estoo (Finland) Tallinn (Estonia)	Interreg	2016–2018	Ended	Navya Arma EasyMile EZ10

collaborations, and the return of experience from pilots sites, the ACS readiness is approaching to shift the urban mobility toward a smart transportation system.

Abbreviations

ACS Automated City Shuttle

ARCADE Aligning Research and Innovation for Connected and Automated Driving in Europe

SAE Society of Automotive Engineering

SPACE Shared Personalised Automated Connected vEhicles

STAD Spatial and Transport Impacts of Automated Driving

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Document History

#	Date	Description
0.1	30/04/2021	Initial version

The Information Security Group

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Information Science Institute