

Autonomous Vehicles to Evolve to a New Urban Experience

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Community for urban transport automation report

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Acronyms

|  |  |
| --- | --- |
| ADS | Automated Driving Systems |
| AI  | Artificial Intelligence |
| AM | Automated Mobility |
| API  | Application Protocol Interface |
| AV  | Automated Vehicle |
| BM | Bestmile |
| BMM | Business Modelling Manager |
| CAV  | Connected and Automated Vehicles |
| CB | Consortium Body |
| CERN  | European Organization for Nuclear Research |
| D7.1 | Deliverable 7.1 |
| DC | Demonstration Coordinator |
| DI | The department of infrastructure (Swiss Canton of Geneva) |
| DMP  | Data Management Plan |
| DSES | Department of Security and Economy - Traffic Police (Swiss Canton of Geneva) |
| DTU test track  |  Technical University of Denmark test track |
| EAB | External Advisory Board |
| EC | European Commission |
| ECSEL  | Electronic Components and Systems for European Leadership |
| EM | Exploitation Manager |
| EU | European Union |
| EUCAD  | European Conference on Connected and Automated Driving |
| F2F | Face to face meeting |
| FEDRO  |  (Swiss) Federal Roads Office |
| FOT  | (Swiss) Federal Office of Transport |
| GDPR  | General Data Protection Regulation |
| GIMS  | Geneva International Motor Show |
| GNSS  | Global Navigation Satellite System |
| HARA  | Hazard Analysis and Risk Assessment |
| IPR | Intellectual Property Rights |
| IT  |  Information Technology |
| ITU  |  International Telecommunications Union |
| LA | Leading Author |
| LIDAR | Light Detection And Ranging |
| MEM | Monitoring and Evaluation Manager |
| MT | MobileThinking |
| OCT | General Transport Directorate of the Canton of Geneva |
| ODD  |  Operational Domain Design |
| OEDR  | Object And Event Detection And Response |
| OFCOM | (Swiss) Federal Office of Communications |
| PC | Project Coordinator |
| PEB | Project Executive Board |
| PGA | Project General Assembly |
| PRM  |  Persons with Reduced Mobility  |
| PSA  | Group PSA (PSA Peugeot Citroën) |
| PTO  |  Public Transportation Operator |
| PTS  |  Public Transportation Services |
| QRM | Quality and Risk Manager |
| QRMB | Quality and Risk Management Board |
| RN | Risk Number |
| SA | Scientific Advisor |
| SAE Level  | Society of Automotive Engineers Level (Vehicle Autonomy Level) |
| SAN | (Swiss) Cantonal Vehicle Service |
| SDK  | Software Development Kit |
| SLA | Sales Lentz Autocars |
| SMB | Site Management Board |
| SoA | State of the Art |
| SOTIF  | Safety Of The Intended Functionality |
| SWOT  | Strengths, Weaknesses, Opportunities, and Threats. |
| T7.1 | Task 7.1 |
| TM | Technical Manager |
| TPG | Transport Publics Genevois |
| UITP  | Union Internationale des Transports Publics (International Transport Union) |
| V2I | Vehicle to Infrastructure communication |
| WP | Work Package |
| WPL | Work Package Leader |

Executive Summary

The development of new technology such as autonomous vehicles and new services in public transport requires the support of different communities of experts and experimenters. This provides the common experience and feedback necessary to accelerate the development work.

Each community offers the possibility to explore the issue of autonomous vehicles from a particular angle that can combine political, technological and regulatory aspects.

Holo, TPG, Sales-Lentz, and Keolis are all involved in different organisations that allow them to complement the knowledge gained in the H2020 Avenue programme, but also to bring the experience gained in these consortia to H2020 Avenue.

In each of the examples provided by the H2020 Avenue partners, we can see the involvement of local authorities who, through their presence, define the opportunities and threats for the development of autonomous vehicles in the area for which they are responsible.

These different visions of the development of autonomous vehicles could be commented at the end of the project (and in connection with WP9 on regulatory aspects), in order to highlight the possible gaps and incompatibilities or synergies that may exist between these different approaches.

# Introduction

AVENUE aims to design and carry out full-scale demonstrations of urban transport automation by deploying, for the first time worldwide, fleets of Automated minibuses in low to medium demand areas of 4 European demonstrator cities (Geneva, Lyon, Copenhagen and Luxembourg) and 2 to 3 replicator cities. The AVENUE vision for future public transport in urban and suburban areas, is that Automated vehicles will ensure safe, rapid, economic, sustainable and personalised transport of passengers. AVENUE introduces disruptive public transportation paradigms on the basis of on-demand, door-to-door services, aiming to set up a new model of public transportation, by revisiting the offered public transportation services, and aiming to suppress prescheduled fixed bus itineraries.

Vehicle services that substantially enhance the passenger experience as well as the overall quality and value of the service will be introduced, also targeting elderly people, people with disabilities and vulnerable users. Road behaviour, security of the Automated vehicles and passengers’ safety are central points of the AVENUE project.

At the end of the AVENUE project four-year period the mission is to have demonstrated that Automated vehicles will become the future solution for public transport. The AVENUE project will demonstrate the economic, environmental and social potential of Automated vehicles for both companies and public commuters while assessing the vehicle road behaviour safety.

## On-demand Mobility

Public transportation is a key element of a region's economic development and the quality of life of its citizens.

Governments around the world are defining strategies for the development of efficient public transport based on different criteria of importance to their regions, such as topography, citizens' needs, social and economic barriers, environmental concerns and historical development. However, new technologies, modes of transport and services are appearing, which seem very promising to the support of regional strategies for the development of public transport.

On-demand transport is a public transport service that only works when a reservation has been recorded and will be a relevant solution where the demand for transport is diffuse and regular transport is inefficient.

On-demand transport differs from other public transport services in that vehicles do not follow a fixed route and do not use a predefined timetable. Unlike taxis, on-demand public transport is usually also not individual. An operator or an automated system takes care of the booking, planning and organization.

It is recognized that the use and integration of on-demand Automated vehicles has the potential to significantly improve services and provide solutions to many of the problems encountered today in the development of sustainable and efficient public transport.

## Fully Automated Vehicles

A self-driving car, referred in the AVENUE project as **a Fully Automated Vehicle** (**AV**), also referred as Autonomous Vehicle, is a vehicle that is capable of sensing its environment and moving safely with no human input.

The terms *automated* *vehicles* and *autonomous* *vehicles* are often used together. The Regulation 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles defines "automated vehicle" and "fully automated vehicle" based on their autonomous capacity:

* An "automated vehicle" means a motor vehicle designed and constructed to move autonomously for certain periods of time without continuous driver supervision but in respect of which driver intervention is still expected or required
* "fully automated vehicle" means a motor vehicle that has been designed and constructed to move autonomously without any driver supervision

In AVENUE we operate ***Fully Automated minibuses for public transport***, (previously referred as Autonomous shuttles, or Autonomous buses), and we refer to them as simply *Automated minibuses* or *the AVENUE minibuses.*

In relation to the SAE levels, the AVENUE project will operate SAE Level 4 vehicles.



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### Automated vehicle operation overview

We distinguish in AVENUE two levels of control of the AV: micro-navigation and macro-navigation. Micro navigation is fully integrated in the vehicle and implements the road behaviour of the vehicle, while macro-navigation is controlled by the operator running the vehicle and defines the destination and path of the vehicle, as defined the higher view of the overall fleet management.

For micro-navigation Automated Vehicles combine a variety of sensors to perceive their surroundings, such as 3D video, LIDAR , sonar, GNSS, odometry and other types sensors. Control software and systems, integrated in the vehicle, fusion and interpret the sensor information to identify the current position of the vehicle, detecting obstacles in the surround environment, and choosing the most appropriate reaction of the vehicle, ranging from stopping to bypassing the obstacle, reducing its speed, making a turn etc.

For the Macro-navigation, that is the destination to reach, the Automated Vehicle receives the information from either the in-vehicle operator (in the current configuration with a fixed path route), or from the remote control service via a dedicated 4/5G communication channel, for a fleet-managed operation. The fleet management system takes into account all available vehicles in the services area, the passenger request, the operator policies, the street conditions (closed streets) and send route and stop information to the vehicle (route to follow and destination to reach).

###  Automated vehicle capabilities in AVENUE

The Automated vehicles employed in AVENUE fully and automatically manage the above defined, micro-navigation and road behaviour, in an open street environment. The vehicles are Automatically capable to recognise obstacles (and identify some of them), identify moving and stationary objects, and Automatically decide to bypass them or wait behind them, based on the defined policies. For example with small changes in its route the AVENUE mini-bus is able to bypass a parked car, while it will slow down and follow behind a slowly moving car. The AVENUE mini-buses are able to handle different complex road situations, like entering and exiting round-about in the presence of other fast running cars, stop in zebra crossings, communicate with infrastructure via V2I interfaces (ex. red light control).

The mini-buses used in the AVENUE project technically can achieve speeds of more than 60Km/h. However this speed cannot be used in the project demonstrators for several reasons, ranging from regulatory to safety. Under current regulations the maximum authorised speed is 25 or 30 Km/h (depending on the site). In the current demonstrators the speed does not exceed 23 Km/h, with an operational speed of 14 to 18 Km/h. Another, more important reason for limiting the vehicle speed is safety for passengers and pedestrians. Due to the fact that the current LIDAR has a range of 100m and the obstacle identification is done for objects no further than 40 meters, and considering that the vehicle must safely stop in case of an obstacle on the road (which will be “seen” at less than 40 meters distance) we cannot guarantee a safe braking if the speed is more than 25 Km/h. Note that technically the vehicle can make harsh break and stop with 40 meters in high speeds (40 -50 Km/h) but then the break would too harsh putting in risk the vehicle passengers. The project is working in finding an optimal point between passenger and pedestrian safety.

Due to legal requirements a **Safety Operator** must always be present in the vehicle, able to take control any moment. Additionally, at the control room, a **Supervisor** is present controlling the fleet operations. An **Intervention Team** is present in the deployment area ready to intervene in case of incident to any of the mini-busses.

## Preamble

Work package 3 “Cooperation for value creation” aims to gather different stakeholders involved in autonomous vehicles projects and to create a web of collaborations to reach a broader spectrum of people to maximize the output value of AVENUE.

One of the means to reinforce the collaboration is the creation and active participation in related communities. The original idea of the project was to create a community for Urban transport, bringing together all the actors in Europe and internationally. At the time of the proposal this type of communities was under development and the project proposal considered that we would be able to create and federate the related actors under an AVENUE community. However, very fast, and due to the interest of the autonomous vehicles in public transportation, several major actors, be national or international, created interest groups bringing together large numbers of actors.

Therefore, our strategy changed and instead of creating yet-another-community, we decided that it would be best to actively join the existing international communities and join/initiate new national communities.

# Communities of Urban Transport

## Existing Urban Transport Communities

In Europe we have an important number of communities in the domain of Urban transport, bringing together different actors in the public transportation arena. The AVENUE project, either as a project or via its project partners, has an active presence and participation the almost all of the major European and international communities, where it has established itself as the leading project in the deployment of fully Automated Vehicles in Urban Transportation. In the following we give a brief presentation of the most important international and European communities and describe briefly the AVENUE involvement.

The first community for Public Transport is **UITP** - The International Association of Public Transport (https://www.uitp.org/). Established in 1885, it is a worldwide network bringing together all public transport stakeholders and all sustainable transport modes. AVENUE, has established direct contact and participates in events and discussions organised by UITP (which is the coordinator of the SHOW project, where many AVENUE partners participate).

**POLIS** is the community of cities and city authorities (https://www.polisnetwork.eu/). It was established in 1989 by European local and regional authorities with target to promote sustainable mobility through the deployment of innovative transport solutions. POLIS organizes events and promotes the exchange of experiences and the transfer of knowledge between European local and regional authorities. CERTH, project partner, is member of POLIS and is actively promoting the AVENUE project to other POLIS members.

**EIT Urban Mobility** is an initiative of the European Institute of Innovation and Technology (EIT - https://www.eiturbanmobility.eu/). Since 2019 it targets to encourage “positive changes in the way people move around cities in order to make them more liveable places”. The EIT partners include cities and regions, academic, Industry and research actors in the domain of Urban Mobility, CERTH and Siemens are partners of the EIT Urban Mobility, promoting and communicating the AVENUE advances and results.

**CIVITAS** is a network *of and for cities*. Launched in 2002, it has today over 330 local authorities as members (https://civitas.eu/cities). CIVITAS acts as a “network of cities, for cities, dedicated to sustainable urban mobility”, fostering political commitment and boosting collective expertise, with target the creation of climate-neutral and resilient cities.

**ERTICO** – **ITS Europe** is a public-private partnership of 120 companies and organizations representing service providers, suppliers, traffic and transport industry, research, public authorities, user organisations, mobile network operators, and vehicle manufacturers (https://ertico.com/). ERTICO develop, promote and deploys Intelligent Transport Systems and Services (ITS) through a variety of activities including European co-funded projects, innovation platforms, international cooperation, advocacy and events. ERTICO is the organiser of the annual ITS regional and global Congress in Europe. CERTH and Siemens are partners of ERTICO. The AVENUE project is actively collaborating with ERTICO and has been invited and participated in many events organized by ERTICO.

## National Urban Transport communities

Our adapted stategy was to concentrate in the creation and/or participation to about to be created/new/existing communities in the different countries, and especially in those where we operate demonstrators or have major technical partners.

### Switzerland

#### Swiss Association for Autonomous Mobility

Although Switzerland was one of the first countries to experiment with Automated min-buses, there was no formal entity/body/community to allow exchange of information between the different actors. Each city, organisation was testing automated vehicles and informal information was provided in meetings. The demonstrator of the TPG changed the Swiss point of view, since the ambition and results were beyond what was until AVENUE done in Switzerland. The Federal Authorities took a more active role (join the AVENUE project as advisory board member), the other sites realised that on-demand is feasible and the services provided by Bestmile showed that Switzerland has all the ingredients to further develop automated mini-busses in public transportations.

With the Initiative of TPG, a new body was created, the SAAM - Swiss Association for Autonomous Mobility, where all the major actors in Switzerland participate.

Two current AVENEU partners are members of SAAM (TPG and Bestmile) and two more from the new, under integration partners for the replicator site of Uvrier (PostAuto and HES-SO). Furthermore the managing director is Mr. Martin Neubauer, ( leader of the under integration in the AVENUE project replicator site of Uvrier) while Mme Anne Mellano is member of the board.

SAAM considers that Autonomous vehicles will fundamentally change mobility as we know it today. Its mission *is to enable the introduction of new technologies and offerings in Switzerland for the common good*.

SAAM is targeting to advance and promote new concepts at all related domains, and namely Regulatory, Public Acceptance, Technology and Commercial Offering.

SAAM unites al active projects deploying automated vehicles in Switzerland, and namely

* Sion, Uvrier – PostAuto (AVENUE future duplicator site)
* Marly - Transports publics fribourgeois
* Schaffhausen – Swizz Transit Lab
* Bell-Idee – PTG (AVENU site)
* Zug - SBB
* Bern – BERNMOBIL
* Zurich – VBZ Zurich.

and federates academia, industry and public operators from all over Switzerland.

(https://www.swissaam.ch/)

#### Nomads Mobility Hub

The Greater Geneva area, which is experiencing strong and sustained economic and demographic growth, is facing considerable mobility challenges. This population basin of just over one million inhabitants, straddling two countries, must continually monitor its mobility dynamics. As a result, travel within this territory is considered a strategic axis to be developed and maintained by the authorities of Greater Geneva. A clear orientation is also displayed: the mobility solutions introduced must be clean and sustainable. Mobility is one of the main vectors of efforts to reduce our environmental impact.

Based on this observation and the desire to associate institutional, private and academic actors in this collective commitment, the Mobility Hub was born during the European Assizes of the Energy Transition in February 2018. The objective of the Mobility Hub is to develop sustainable and innovative mobility solutions to promote the energy transition on roads, railways, waterways or in the air and to integrate them into Smart Cities projects, building on the shared know-how and the multiple specialized skills gathered within the Mobility Hub.

The Geneva based Swiss AVENUE partners (university of Geneva, TPG, State of Geneva) have joined the hub from its first days in 2018, where they promote the AVENUE results and collaborate in the creation of policies for the mobility in the Greater Geneva Area.

(https://nomadsfoundation.com/hub-mobilite/)

### France

#### Autonomous Vehicles Club - Keolis

In order to bring together experts and other players in the autonomous vehicle market, Keolis has created the Autonomous Vehicle Club, a community of external and internal Keolis members. The aim of this club is to better understand the key challenges of operating a fleet of autonomous vehicles. This internal Keolis group club was launched in September 2019 with brainstorming, lessons learned and discussions on the future of autonomous vehicle services.

This community should enable the Keolis group to pool the experience gained to benefit all the group's subsidiaries, but also to create partnerships with autonomous shuttle manufacturers. The aim is to exchange information on the industrial specificities of manufacturers and PTOs in order to help the market deliver approved and operational vehicles as soon as possible.

#### SAM - Sécurité et Acceptabilité de la Mobilité autonome

In April 2019, the French Ministry of Transportation has launched an RFP thru the “Investissement d’Avenir” ADEME structure. This initiative and the EVRA “Expérimentation du Véhicule Routier Autonome“ take part of the government willingness to promote autonomous vehicles solutions

The SAM project for Safety and Acceptability of Autonomous Driving and Mobility brings together a consortium of industrial players, research and territorial partners, in response to the Call for Autonomous Road Vehicle Experimentation Projects (EVRA) launched by ADEME as part of the Future Investment Program (PIA) in June 2018. The project started in July 2019 for 3 years.

The 13 experiments carried out and studied within the SAM project cover five use cases of autonomous vehicles: autonomous driving on divided lanes, parking valet, on-demand transport services, autonomous bus line services and last mile delivery. This project aims to create a common good by pooling technical and academic knowledge on safety, acceptability and environmental and socio-economic impacts.

Keolis is part of one of the awarded consortia (SAM “Sécurité et Acceptabilité de la Mobilité autonome”) and as a consequence is deeply involved in the workshops that are related to operations, safety, cybersecurity, passenger acceptability, homologation, etc. with partners such as Renault, PSA, Alstom, EasyMile, RATP, Vedecom, IRT SystemX etc. A part of this activity is dedicated to public entities (PTA Public Transport Authorities, Cities, Metropolis, etc.) that form the “Collège des Territoires”, a place where they will be able to brainstorm with the industry experts on the possibilities and the conditions to deploy autonomous vehicle solutions.

Navya is part of the other awarded consortia (ENA “Expérimentation de Navettes Autonomes”).

(https://librairie.ademe.fr/mobilite-et-transport/289-sam.html)

#### STPA - Services de Transports Publics Autonomes

In addition of this initiative, the French mobility industry leaders are also involved at the Ministry level into missions to help the public bodies to legislate to allow the future autonomous mobility services. Within the STPA (Services de Transports Publics Autonomes) group, public transport operators like Keolis are involved to imagine the future conditions of operation. From the homologation of the vehicle, to the security of the operation and the list of use cases, the deliverable created will allow the government to foster competitiveness of the French industry.

### Denmark

Amobility is active member in the 2 linked Scandinavian communities ITS Danmark and ITS Norway (https://its.dk/).

ITS Denmark and Norway are independent membership organizations representing ITS suppliers, authorities and research institutions working with intelligent transport systems and solutions, creating value for society and enabling the introduction of user-friendly smart mobility and logistics services.

ITS Denmark strive to close the gap between research and industry for a stronger synergy and the best possible solutions within ITS. With our expertise we contribute to the expansion of ITS in Denmark. This includes the benefits that ITS can provide in terms of traffic safety, economic efficiency, environmental advantages and legislation in the field of ITS.

The members of ITS Denmark are working with intelligent traffic solutions on different levels in different industries and public organizations. Members benefit from ITS Denmark activities such as seminars, webinars, professional networks and regular news updates.

Amobility of also member of YAGO, a cluster collaboration with central part an autonomous test centre.

YAGO has its origins in the interaction between different actors, who are genuinely interested new the development of new mobility solutions in Norway. Based on experience gained in the deployment of autonomous vehicles the YAGO cluster for autonomous technologies at Forus was established. YAGO aims to create growth with the help of local actors.

### Luxembourg

Sales Lentz have been named as a contact entity for the participation in the study/project "CCAM Readiness Luxembourg", for the preparation of which the TÜV Rheinland Consulting GmbH has been commissioned by the Ministère de l’Économie Luxembourg. The aim of the *Study on cooperative, connected and automated mobility (CCAM) readiness Luxembourg* is to record needs and jointly identify measures in order to promote automated driving in Luxembourg.

“The Partnership aims to harmonise European R&I efforts to accelerate the implementation of innovative CCAM technologies and services. It aims to exploit the full systemic benefits of new mobility solutions enabled by CCAM: increased safety, reduced environmental impacts, and inclusiveness. By bringing together the actors of the complex cross-sectoral value chain, the Partnership will work on a shared, coherent and long-term R&I agenda. The Vision of the Partnership is: European leadership in safe and sustainable road transport through automation “(source: https://ec.europa.eu/info/sites/default/files/research\_and\_innovation/funding/documents/ec\_rtd\_he-partnerships-connected-and-automated-driving-ccam.pdf)

The participants of this working group are the key actors of mobility in Luxembourg:  Ministère de l’écomomie, Ministère de la mobilité et travaux publics, SNCA (National Society of Automobile Traffic), TÜV Rheinland Consulting GmbH. Sales-Lentz participated in a workshop in Mai 2021 to talk about the homologation-process for new and specialized vehicles in Luxembourg. The results will be part of the final study, which is going to be finished at the end of February 2022. The internal organisation of the ministries and the infrastructure requirements will also be part of the study. For now, it is not possible to define the real outcome from the participation and the transferability to the AVENUE project. This has to be done after the publication of the study.

# Conclusions

By the double action of participation in European Communities and initiating/joining national communities/groups in mobility, the project partners are able to not only promote the AVENUE results, but also influence the decisions and regulatory frameworks at national and international levels. The AVENUE project participation and its results give the project partners not only experience but also establish them are legitimate experts and actors in the Autonomous Mobility domain.

The work on the different communities will continue beyond the project termination, with the continuous active participation of the project partners in the existing and new communities that will be eventually created in different European countries.