Automated buses in Europe
An inventory of pilots: Final Version

Hagenzieker, Marjan; Boersma, Reanne; Nuñez Velasco, Pablo; Ozturker, Maryna; Zubin, Irene; Heikoop, Daniël

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Authors:

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By

Hagenzieker, Marjan
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Zubin, Irene
Heikoop, Daniël

An electronic version of this technical report is available at http://repository.tudelft.nl/.

Cover picture: Opening shuttle ESA ESTEC. Picture: Irene Zubin

TU Delft

Contents

Abstract

Automated bus systems are a promising means of future first- and last mile public transport solutions, and can even possibly become a regular part of the public transport network. Therefore, many projects appear throughout Europe to pilot the feasibility of automated bus system implementation on various locations. Keeping up with the rapidly increasing pace in which these pilots appear, this report aimed to provide an overview of past, currently on-going, and concretely planned pilots with automated bus systems in Europe. Via extensive internet searches, exhausting personal networks, and gathering information from other sources, a detailed overview was developed. In the first version, established March 2020, 118 pilots were found which were characterized by vehicles with predominantly low speeds, low capacities, and short operation routes. In this final version, established February 2021, aside from additional information on known pilots, another 13 were found, making a total of 131 pilots throughout Europe. The search in itself proved to be difficult due to the often lacking detailed information of pilots, which was argued to be due to most scientific pilots being of recent years, and therefore often still on-going, and consequentially not having published any information yet on their research. Another difficulty arose due to the rapid increase of occurring pilots with automated buses, which leads to the report already being out-of-date as this report is being written. Therefore, this report was updated early 2021. Meanwhile, the Covid-19 pandemic situation appears a major issue for automated bus systems pilots during the year 2020. The results show that currently the vast majority of automated bus system pilots occur with the presence of a steward on board, due to legislation, technological challenges, as well as passengers requesting them, raising concerns regarding (e.g., economic) efficiency. Although there are a few automated bus systems that actively show efficient operation without on-board stewards, this still appears to be a future development.

Acknowledgements

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1. Introduction

As is becoming increasingly apparent, driving is turning into a task for an automated system instead of a human being. Public transport is considered as one of the more suitable candidates to benefit from automating driving tasks (Shladover et al., 2016). Henceforth, an increasing number of automated (mini)bus systems is entering our roads, often driving in mixed traffic environments including cyclists and pedestrians. As a result, projects involving automated public transport systems are appearing with accelerating pace, and keeping up to date about their current developments is becoming increasingly cumbersome. A comprehensive overview of all these projects would provide valuable insights. Overviews like this do exist, but are not always (kept) up-to-date and usually lack the detailed information needed for research purposes. For instance, the Bloomberg.org Group created an interactive map on current and planned projects involving autonomous vehicles (Bloomberg.org Group, 2020), and Connected and Automated Driving Europe's website gives an overview of European projects in the field of automated road transport (Connected and Automated Driving Europe, 2020), but these are not exhaustive, and detailed information is often not provided. When narrowing down to automated bus systems, finding an exhaustive and up-to-date overview of completed, running, and planning projects becomes even more challenging. From a technological, energy efficiency, and legality perspective, a recent overview article investigated predominantly European completed and ongoing automated bus projects (Ainsalu et al., 2018). It is important to keep an even pace with technology, and, if we want to have the consumer (keep) using promising novel technology, maintain an up-to-date knowledge base of how humans (prefer to) interact with such technologies as automated bus systems. As a first step, an inventory of what has been done, is going on, and will be investigated in the near future, appears therefore warranted.

Henceforth, in the present document we present an inventory of real-life projects with automated bus systems in urban settings. This work was conducted as part of the Autobus project https://www.toi.no/autobus/ funded by the Norwegian Research Council. The inventory is not complete, mainly because many new pilots and demo's pop up all the time, and many of those are not well documented. Pilots and projects in countries represented in the Autobus consortium (Norway, the Netherlands, Belgium, & Sweden) are probably more complete than those in other countries. We have attempted to collect as much information as possible in a systematic way. The first report, upon which this final report is a continuance, was developed throughout and up to the end of 2019, while this final report updated the initial report in the first months of 2021.

Within the Autobus project, also other studies are conducted. Recently, two systematic reviews have been performed. One with a focus on passenger experience and road user interaction (Heikoop et al., 2020) and another on empirical studies from interviews, focus group discussions, surveys, and (video) observations directly addressing the interactions between cyclists and autonomous vehicle (AV) shuttles (Hagenzieker et al., 2019). Findings of these reviews include that:

- Public and passengers are generally enthusiastic about the AV shuttles,
- The AV shuttles are not mature; they stop when any object (e.g., road users, static object, etc.) is within a certain distance from the bus,
- The AV shuttles' speed is slow; often slower than the speed of cyclists and other surrounding traffic,
- AV shuttles often drive on existing infrastructure, sharing the road with cyclists, or use the cycle track,
- Infrastructural characteristics (e.g., markings, shared or separate road) influence observed interactions, which appear to be more risky on shared narrow roads,

Other studies within the project, also focusing on the interaction of road users with automated bus systems, are in progress. These involve surveys among passengers, pedestrians, and cyclists related to their interaction with automated bus systems driving in Norway and analyses of real-life observations on various routes where automated bus systems interact with other road users. First preliminary findings (Bjørnskau et al., 2019) show that:

- Cyclists' opinions and safety perceptions become more positive after having interacted with AV shuttles,
- Cyclists seldom force the bus to stop, but interactions change: cyclists give less often way to the AV shuttles over time, whereas pedestrian behaviour does not seem to change,
- Cyclists cross having a very short distance ahead of the AV shuttle,
- The AV shuttles' abrupt breaking can cause the cyclist to perform unexpected moves,
- Slowness of bus leads to many overtakings by cyclists (and by motor vehicles),
- A common observation is that cyclists ride alongside (left or ride) or overtake the AV shuttle, which can cause abrupt braking (too short distance to shuttle).

Figure 1 – WePod and cyclists in the Netherlands. Picture: Delft University of Technology

Figure 2 – Automated shuttle in Oslo, Norway. Picture: Marjan Hagenzieker

Figure 3 – Automated shuttle in Frankfurt, Germany. Picture: Roberto Giraldi

Figure 4 – Automated shuttle in Appelscha, the Netherlands. Picture: Reanne Boersma

2. Methods

In- and exclusion criteria

The aim of this research was to inventory pilots and projects with automated bus systems throughout Europe that are, will be, or have been running, to present an as complete picture of the current state-of-the-art involving automated bus systems in Europe. This therefore excludes demos or showcases, as those are often not well documented, and operating in optimal conditions and do not give a realistic view of long term implementation of the vehicle. Although this research did not actively searched for short-term demos or showcases, some can be included when they are deemed relevant to present in this overview, for instance due to the abundance of information, or it being a landmark demo or showcase ushering in new possibilities. This research was specified to find automated bus systems operating on public roads with mixed traffic. Pilots on closed roads can be included, however, when they are (similar to above) deemed relevant enough for presentation in this overview. The vehicle type was narrowed down to a vehicle that was able to transport people as public transport. That excludes private automated cars such as the (concept) cars presented by Google, Tesla, Volvo and Mercedes. Pilots that did not take place, such as the Citymobil project in Rome (Delle Site, Filippi, & Giustiniani, 2011), were excluded from the report. The entire research took place between January and March 2019, between November 2019 and January 2020, and between January and February 2021.

Step-by-step methodology

For the development of this report, several steps have been taken. First, several main online sources were utilized (see Table 1), and complemented with other relevant online sources such as university- and news websites. Second, a semi-structured review was conducted. Third, the results from this review were analysed for relevant content. Fourth, this relevant content was used for both forward- and backtracking of other relevant content (i.e., finding relevant citations leading to other pilots or projects, and finding additional information through searching for keywords found in news articles). Lastly, personal networks were broached to supplement the resulting data base with pilots and/or projects that are not (easily) retrievable through an online research.

Table 1 — Main sources of the online research used for developing the overview of pilots and projects with automated bus systems in Europe.

Title	Reference	Type
Implementing Automated Road Transport Systems in Urban Settings	Alessandrini, 2018	Book
State of the art of automated buses	Ainsalu et al., 2018	Review journal article
Initiative on Cities and Autonomous Vehicles	Bloomberg.org Group, 2020	Online inventory
Cybercars	Parent, 2019	Blog
SPACE UITP	SPACE UITP, 2020	Project website
AVENUE	Avenue, 2020	Project website
Easymile	Easymile, 2020	Company website
Navya	Navya, 2020	Company website

The semi-structured review was performed using various search engines, namely Google Scholar, Web of Science, ScienceDirect, Scopus, and ResearchGate. Narrowing down the scope of the research, keeping the method both valid and viable, the search was restricted to only pilots and projects on automated bus systems in Europe. Next, a set of search terms was determined, seen in Table 2, which, combined, formed the search queries that were used for this research. The results from this research were consequently filtered for relevant topics, meaning that the content should be on public transport vehicles only, cover pilots or projects (i.e., not demos or showcases), indicating (quasi-)long-term employment of the automated bus system, and provide ample information for filling out at least most of the relevant details for the overview table of this report.

From these results, other relevant sources were extracted, namely references found in reference lists and keywords from news articles. These sources were used as keyword search terms for a follow-up online search, after which its results were added to the rest of the results.

The final method used in this research was utilizing the authors' personal networks, meaning that the authors gathered information by attending relevant conferences, project meetings, and workshops, conversed with other relevant researchers and stakeholders, and took their own personal experience into account. These results were also added to the rest of the results.

Table 2 – Overview of terms used for the online search, complemented with the languages in which the searches were conducted.

Synonyms of automation	Synonyms of vehicle	Languages
Automated	Vehicle	English
Autonomous	Bus	Dutch
Driverless	Shuttle	French
Self-driving	People mover	Norwegian
	Public transport	Italian
	Public transport solution	Spanish
	Road transport system	German[1]
Cybercar[2]		
Cybernetic transportation system[2]		

2021 update

The 2021 update of this report mainly resorted to internet searches on Google, due to limited temporal- and personnel resources. Therefore, this 2021 update should not be interpreted as all-encompassing.

[1] Only limited use.
[2] "Cybercar" and "Cybernetic transportation system" were separate entries in the online research.

3. Results

Please note that at the time of finalising the first version of this report (November 2019 to January 2020) all the website links used for this research were available. Information in this overview may be outdated at the time of publication. Even though the authors tried to get a complete overview, some pilots might not be mentioned because many new pilots keep coming up and many of those pilots are not well documented. Please feel free to share your information about pilots and projects in Europe if you have any (the authors can be contacted via m.p.hagenzieker@tudelft.nl).

The following presents a narrative of the pilots and projects found in this research. Its focus is to illustrate the development of automated bus systems in Europe, based on the findings from this research. The overview (in table form) of the found pilots and projects from this research can be found as appendix.

The idea of enhancing public transport systems with automated bus systems originates back to the 1990s from the concept of the so-called 'cyber cars', which are in essence a low-passenger-capacity, flexible on-demand service on dedicated infrastructure forming Cybernetic Transport Systems (CTS; Parent, 2019). A demonstration and implementation of such a transport mode, named ParkShuttle, was realized in 1997 in the parking area of Schiphol airport, the Netherlands, which stayed operational until 2004 (2getthere, 2019; Parent, 2019).

Since the early 2000's, a series of research projects (CyberCars, CyberMove, CyberCars2, CityMobil, CityMobil2, etc.) have been focusing on development, improvement, and testing of technology for automated bus systems. From cyber cars with simple obstacle detection system (scanner, laser, and safety bumper) on dedicated closed track (Delle Site, Filippi, & Giustiniani, 2011), it matured into more advanced automated bus systems with complex sets of internal and external sensors for vehicle positioning and navigation, to potentially allow for driving in mixed traffic (Ainsalu et al., 2018). Examples of the latter vehicles are EasyMile's EZ10, Navya's Arma, Local Motors' Olli, and the 3rd generation of ParkShuttle. The only significant difference between the vehicles is that ParkShuttle uses artificial landmarks (i.e., magnets) which are embedded in the roadway for positioning (Boersma, Mica, van Arem, & Rieck, 2018). Interesting to note is that, based on pilots found through the 2021 update of this report, there appears to start a tradition where conventional buses are being automated (see e.g., Ásgrímsson, 2021; "Malaga to trial Spain's first self-driving bus", 2021; "Turkish President Tayyip Erdoğan became the first passenger of Karsan Autonomous' Atak Electric Bus", n.d.).

One of some landmark pilots and projects actually involved a one-day trial in Svalbard, which was in 2019 the first autonomous vehicle operating in the arctic circle. Even though the methodology of this research aimed at excluding short-lived trials like these, the contributory factor of this trial made it relevant enough to include in this report, and is thus consequentially included in the overview to be found in the appendix.

Pilot descriptives

At the time of writing, a total of 131 pilots and projects have arisen, based on the results from this research. Unfortunately, the information about the earliest trials and pilots is scarce, as most of the links to the projects' websites are not working anymore. Wherever possible, the pilots and projects that could be described in enough detail are taken into account in this research, and are presented in the overview (see appendix).

The 131 pilots and projects took place in 20 different countries. The amount of the projects per country is shown in Figure 5, with France (34 projects), Germany (12 projects), and Norway (12 projects) being the three leading countries. Note that the name of the organizing party(ies) or the purpose of the project were used as an indicator of the country of the pilot, as the project itself was often not a clear enough indicator for its location.

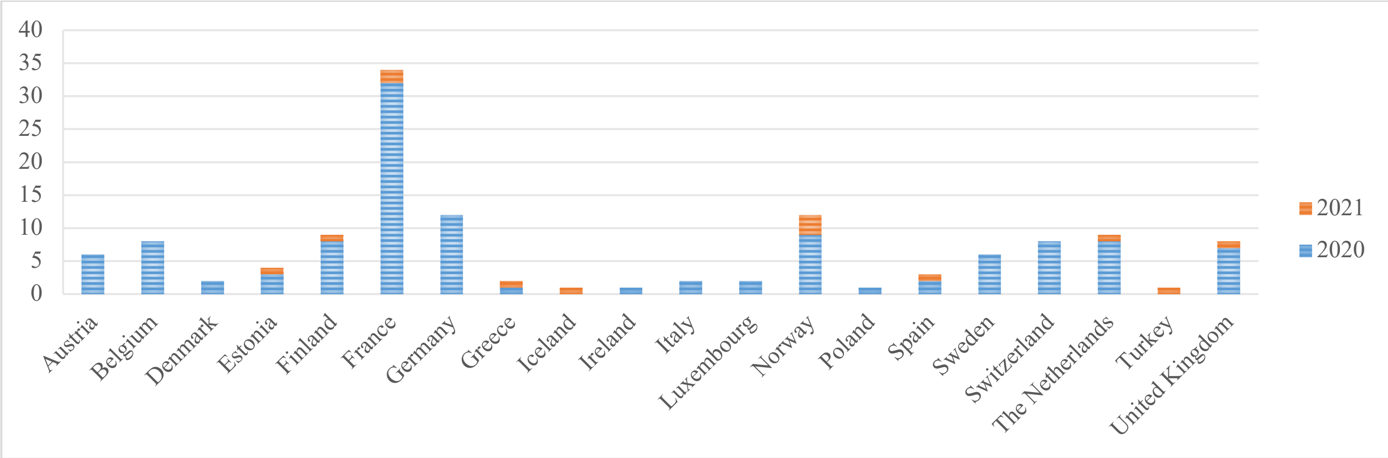

Figure 5 – Amount of pilots per country, listed alphabetically. In blue is the data from 2020; in orange are the additional pilots found with the 2021 update

The starting and ending dates for each pilot were gathered, which are presented in the overview to be found in the appendix. Some pilots report two different starting and ending date; in those cases, more pilots were carried out for the same project in different times. Looking at the starting year of the pilots, the increasing interest in automated bus systems starting from 2016 can be seen, with 2018 and 2019 as peaking years (

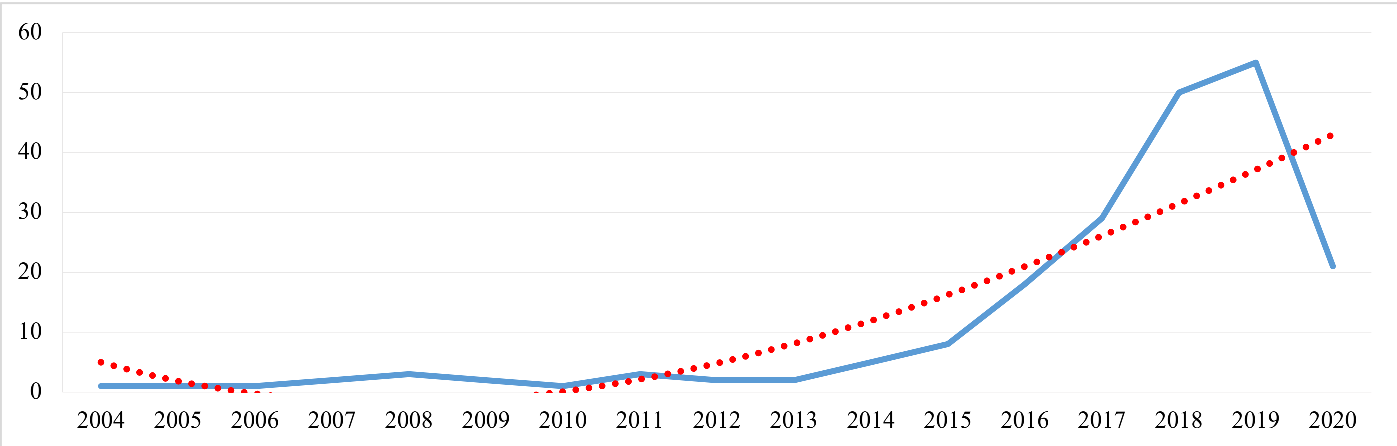

Figure 6). Those two years mark the introduction of a new collection of automated bus systems, such as the minibuses I-Crystal (developed by Transdev and Lohr), Gacha (Miju and Sensible4), MILLApod (Intelligent Systems For Mobility), and HEATbus (IAV), as well as the full-size buses Citywide LF (Scania) and Enviro200 (ADL). This consequentially explains the fact of the dominance of the vehicle types EZ10 (EasyMile) and Arma (Navya), with 61 and 38 pilots, respectively, utilizing these types of vehicles, as those two types have been around much longer (since April and September 2015, respectively). Notably, all vehicles used in the pilots found in this research were fully electric, apart from one: the Mercedes-Benz Future Bus, which operated between Schiphol Airport and the city of Haarlem. Another noteworthy point is the surprisingly small number of pilots in 2020, which likely has a two-fold reason: the Covid-19 pandemic, and the limited resources for the 2021 update. More on this in the Discussion section.

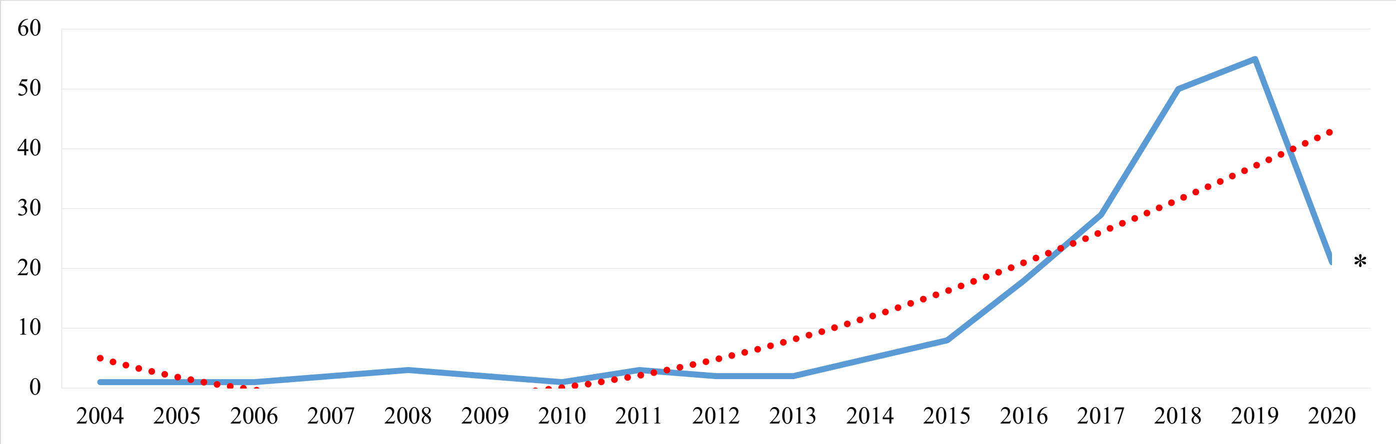

*Figure 6 – Distribution of running pilots per year. Trend line in red dots. Note: the duration of each project is considered; hence, if a project lasts for 2 years, the same project is added to both respective years. *The amount of 2020 pilots is highly likely to be incomplete. See Discussion for explanation*

Passengers

Public transport is per definition intended to transport public. Therefore, this research evaluated the characteristics the pilots have in light of its passengers. Although the maximum passenger capacity of automated bus systems is usually higher, the number of allowed passengers is almost always limited to seated places, with one place reserved for the steward. An overview of the maximum amount of passengers that is allowed in the vehicle is seen in Figure 7. The presence of the steward is mandatory in all projects except for the ParkShuttle (Rotterdam, the Netherlands). This procedure is mostly done for safety reasons, since the automated driving technology is still developing. However, two private trials took place in Oslo, Norway and in Salzburg, Austria without steward on board (see appendix' comments column for more information). Of those pilots for which this data could be found, the vast majority (94%) would only hold less than 20 passengers, while over 70% would not take more than 12 passengers at a time. The seven exceptions are one in Belgium, France, Spain, Sweden, and Turkey, and two in the United Kingdom (numbers 13, 30, 99, 102, 123, 128 and 130 in the appendix, respectively). Note, however, that a large proportion of the pilots did not disclose the number of seats available (i.e., 23%).

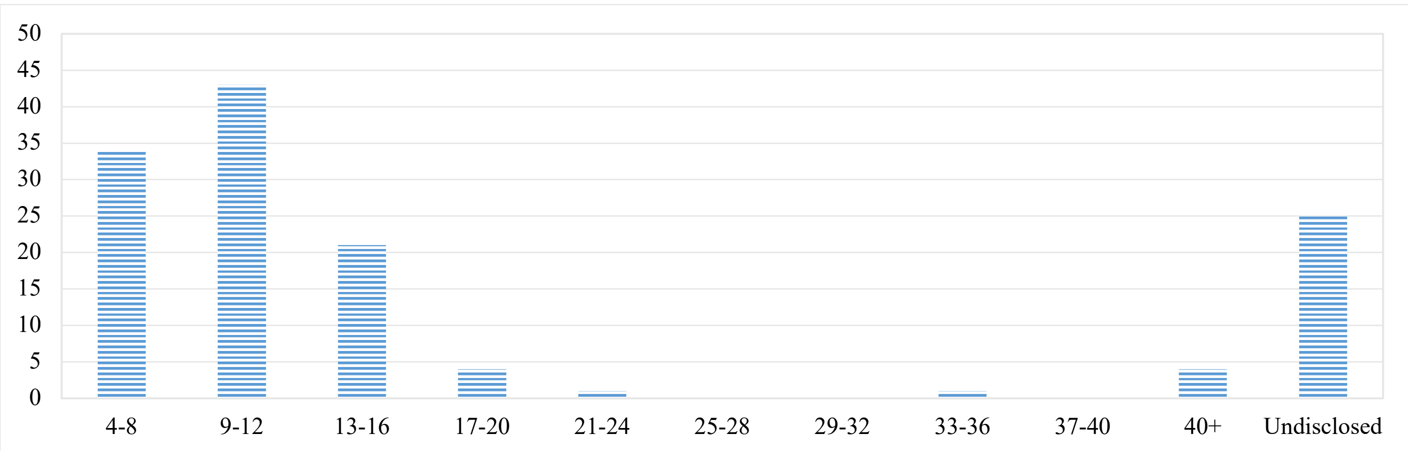

Figure 7 – Maximum allowed passengers in the vehicle

Vehicle- and infrastructural characteristics

The infrastructural adaptations for the automated bus systems mostly include road markings and warning signs, installation of the equipment for V2X communication (sensors, systems to communicate with a control room and traffic lights), and temporary platforms for bus stops.

On the same line of reasoning of the available seats, the allowed speed of the automated bus systems is usually lower than the design speed. Most pilots therefore report two different speed values: one referring to the maximum allowed speed and one to the average operational speed. As with the information regarding capacity, information regarding (operational) speed was not always present. Therefore, only the pilots who reported information regarding operational speed of their automated bus system are taken into account (92 of 131 pilots). Figure 8 shows the average operational speed distribution of the considered pilots. As with the capacity (Figure 7), the average operational speed is low (below 21 km/h) for the vast majority (78%) of the pilots. Only two pilots exceeded 40 km/h (numbers 61 and 110 in the appendix).

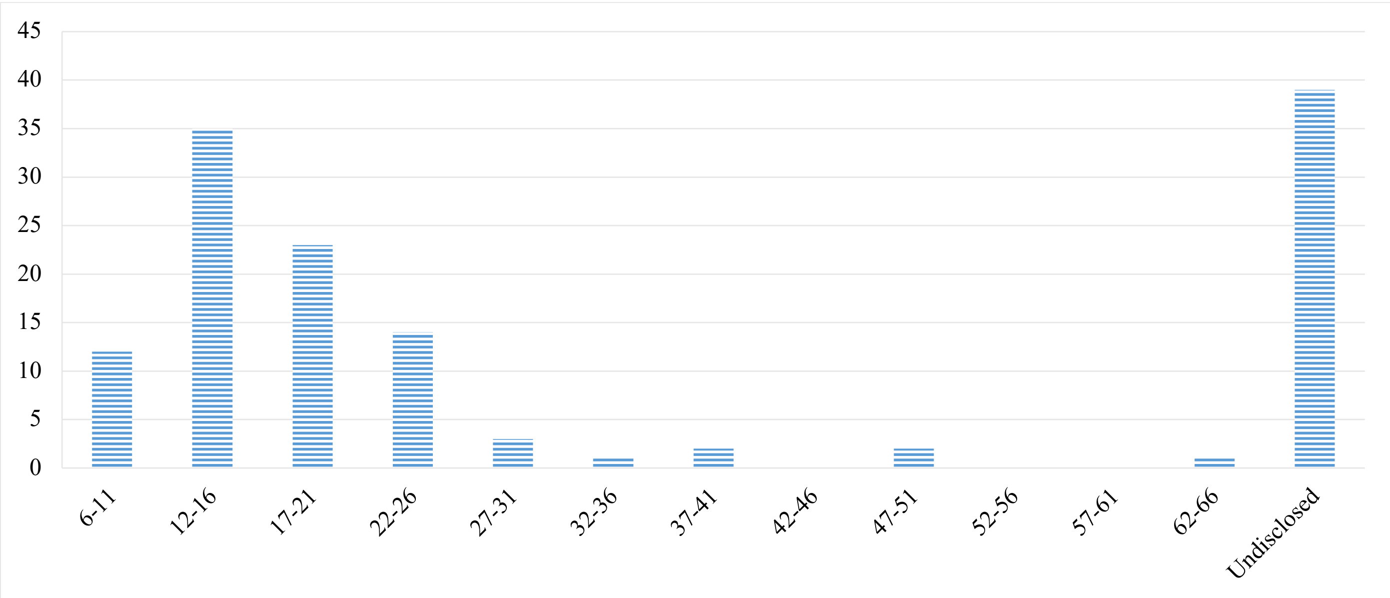

Figure 8 – Number of pilots per average operational speed of the automated bus system in kilometers per hour

The application cases of the automated bus systems are mostly fitting into the concept of first/last mile transport solutions, to provide connections between public transport stops or stations and university campuses, business/shopping districts, or within airports, parking facilities or city centres. A total 95 pilots reported their route length, of which 46% was below 1500m (Figure 9), and 60% below 2500m. Six pilots were longer than five kilometres (numbers 48, 51, 62, 93, 97, and 128 in the appendix). With 28% not reporting the (length of their) routes, these figures could change drastically.

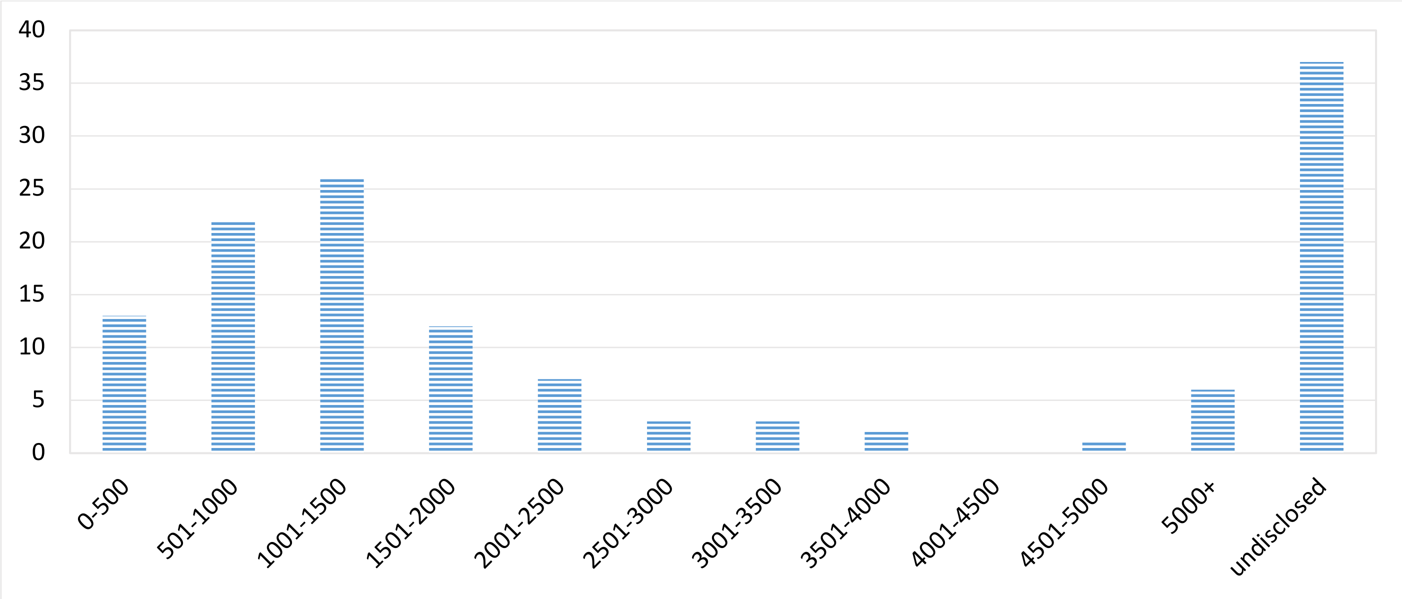

Figure 9 – Number of pilots per route length in meters

4. Discussion and conclusions

The development of automated transport systems is growing explosively, and is therefore difficult to keep track of. This report was aimed at creating an overview of pilots with automated bus systems in Europe that have occurred, are currently running, and will be started in the near future. Recent approaches (e.g., Ainsalu et al., 2019; Bloomberg.org, 2020) were either incomplete, had a different scope, or are not updated regularly. Through an extensive search base, including Google and various academic search engines, 131 demonstrations of automated bus systems have been found throughout Europe. The results in this report, and its accompanying overview table (to be found in the appendix) have been (crudely) updated early 2021, after a thorough inventory throughout 2019.

The majority of the information provided in the appendix table was found through overviews of upcoming or on-going pilots with automated bus systems, as these are commonly well-covered in the press. In contrast, research reports, such as academic journal articles or other types of academic dissemination, during pilots is usually either not documented or not shared. The number of pilots for which detailed documentation was found was 34% of the total amount (i.e., 44 out of 131) of pilots that resulted from the research performed in this report. This included 10 pilots with published research (7.6%), 25 pilots with project reports (19.1%) and 4 pilots with both types of documentation (3.1%), and did not include any on-going studies. Also note that it is likely that there are on-going projects the authors are unaware of. However, it was expected that most of those would have become known and its information available and added in the update of this report in 2021, especially the number of pilots which have been running in 2020 is much lower than expected (see Figure 6). This likely has a two-fold reason, as mentioned in the Method section: the Covid-19 pandemic, and the limited amount of time and resources for the 2021 update. It must be noted, however, that many more somewhat similar demonstrations have been found, but were either too limited in their information, were technically not with automated bus systems, or did not actually go beyond the planning phase. Another note is that the authors of this report acknowledge the timeliness of this report, as it is highly likely that at the point of writing many more pilots have arisen, which is why this report was updated early 2021. Nevertheless, it appears there is still much to discover in terms of pilots with automated bus systems in Europe.

The Covid-19 pandemic likely put a stop to many (planned) pilots with automated bus systems. Although many, if not most, pilots would have been planned at least a year in advance, so that it could have turned up within this report regardless, it is also likely to expect that several pilots that were planned for 2020 did not see the day of light due to this pandemic, and therefore also did not end up in any (news) report for us to find. On the other hand, the time and resources we had for our first inventory was much larger than for the 2021 update. This also is likely to have influenced the amount of pilots found in this update. Although 13 new pilots have been found through mere Google searches, having had the time and the resources to also perform a semi-structured review, extensive forward- and backward tracking, as well as pulling from personal network resources could have increased the findings substantially. Therefore, the reader is encouraged to both get in contact with the authors of this report to supplement to our database, and to take the results from this report (and consequential conclusions) with a grain of salt.

During our research, we encountered several pilots that were never realised, such as the one in Rome within the CityMobil project, in which a Robosoft vehicle was supposed to ride for 2200 meters at a maximum speed of 30 km/h, transporting passengers from a carpark to the entrance of the Rome Exhibition Centre (Delle Site, Filippi, & Giustiniani, 2011). It was decided to discard these pilots from our research, in order to provide a detailed inventory of pilots that are and were conducted in Europe, avoiding biased results for non-existing pilots. On the other hand, however, some pilots have been included in the overview, despite the fact that it did not meet the search criteria of the methodology used in this research. These exceptions were included when it was considered a landmark trial that proved invaluable for future development of automated bus systems. For instance, the Svalbard trial was included, as this marked the first trial with automated bus systems in the arctic circle; something that was deemed impossible or at least incredibly hard due to the harsh weather circumstances.

The lack of a structured search strategy was largely due to the unstructured nature of the variety of pilot goals (e.g., proof of concept, demonstration, pilot, etc.), and therefore regularly lacked a standard location of providing information of said pilots. Therefore, the authors needed to predominantly trust on their own network and expertise in the field, rather than trusting on the internet's knowledge base. It would be worthwhile to test whether a systematic literature review could come up with the same or different pilots on this topic (cf. Heikoop et al., 2020). However, during this research, it was found that the amount of lacking information was abundant, as, for instance, several pilots and/or projects would not clearly document their starting and/or ending date. Therefore, these types of missing information occur regularly in the overview (see appendix). However, when only an ending date was missing, it was assumed that the respective pilot would run until the end of the year it was currently running.

As seen in Figure 6, pilots with automated bus systems are still on the rise (assuming a correction or exception for 2020 pilots). Only since 2016, there appears to be an increase in interest in pilots with automated bus systems, and this interest does not yet seem to die out (again, 2020 pilot results ignored, but rather following the trend line of Figure 6). This report should therefore be seen as an initial stepping stone towards a systematically updated overview of automated bus system pilots throughout Europe. Other similar attempts have also taken place, for example specifically investigating literature on automated bus system-vulnerable road user interaction, with comparable results (Hagenzieker et al., 2019; Heikoop et al., 2020). The authors of this report therefore encourage the readers to contact the authors to provide them with additional information on this topic.

Despite abovementioned limitations, several conclusions can be made about automated bus system pilots in Europe. The first is that proper documentation and information of performed pilots is currently lacking, and any available info is distributed over many different sources. It would benefit practitioners, researchers, and designers/engineers, as well as society as a whole, if detailed information regarding occurring struggles and problems and the found solutions to those were to be provided. Furthermore, sharing results on public perception and interaction with these automated bus systems could also help improving future automated bus systems.

Second, the found pilots mostly show small buses to operate on an on-demand base and as access- and egress mode for main facilities and/or public transport lines. In the previous preliminary draft report (version 1.0), we suggested that in order to make automated bus systems more accessible, future pilots should aim to roll out transit lines throughout larger (and denser) areas. Back then, predominantly first- and last mile problems are being solved with the current line of automated bus systems, meaning technically feasible, but short route lengths and low speeds. More than a year later, even though there appears to occur a shift in pilot goals, from experimental to long term development, and increased usage of regular transit buses, automated bus systems are continued to be placed and piloted at technically feasible locations instead of locations where there is actual demand for them, which increases our already in the previous report existing concern regarding the future of said systems.

Third, although it has been shown that automated bus systems can operate without a steward on board (albeit on closed tracks; see the Netherlands), most pilots still have stewards on board, due to national legislations requiring them. These legislation challenges can also be seen from the results (and Figures 7 to 9), as the passenger allowances, speeds, and route lengths are predominantly impractically slow, as current legislation, rather than technical feasibility, withholds automated bus systems from reaching their limits and therefore practical implementation and utilization. Although the policies exist for guarding the safety of passengers and other road users by limiting the possibilities of automated bus systems (as accidents do occur; see e.g., Gibbs, 2017; Porter, 2019), until countries allow more freedom to automated bus systems, the development of these systems will continue to be held back.

A fourth point is the drop in pilots run in 2020. Although it is likely due to both the Covid-19 pandemic and the imbalance between the two updates in terms of effort (available to) put into it, it could also be that we have reached a ceiling for the number of pilots in Europe. In 2019, 55 pilots were held, following the trend line seen in the previous report (v1.0), the expectancy was to have had well over 70 pilots in 2020. However, already from 2018 to 2019, the increase appears to slow down, which could indicate that indeed a ceiling was (close to be) reached. Further in-depth research, as well as awaiting 2021, and possibly also 2022 (given the fact that Covid-19 regulations are still largely in place throughout Europe) data should help in conclusively saying anything about the trend in the development of automated bus pilots in Europe.

A fifth point is a cautious one, and related to the second point, namely a possible trend in the adoption of regular transit buses for automated bus systems. Three of the thirteen newly found, in or after 2021 (planned to be) running automated bus systems are regular transit buses, which can be considered to be a substantial portion of the fleet. Whether this is due to coincidence within the findings, or to an actual increasing interest in using regular transit buses needs further research.

As a final point, it is surprising to see that even though the Netherlands is leading in automated driving technology readiness, it is being outperformed by France, Germany, and Norway, in terms of number of pilots with automated bus systems (34, 12, and 12, versus 9, respectively). Further investigation is needed to uncover why this discrepancy exists. Plainly based on these results, it appears that current national legislation does not need to hold back nationwide rollouts of automated bus systems. As has been done for this report, the authors encourage researchers and engineers from different countries to work together, to learn from each other in terms of possibilities and limitations, to facilitate a streamlined European-wide development of publicly accepted and appreciated automated bus systems on locations where the demand for them is at its highest.

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Appendix

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
1.	Austria	auto.Bus - Seestadt	Seestadt	June 2019 - end date not mentioned	Navya Arma	Max 11 passengers (11 seated and 0 standing)	Max 20 km/h	Test track leads from the subway station Seestadt via the stops "Seeseiten", "Susanne-Schmida-Gasse", "Schenk-Danzinger-Gasse" and "Maria-Tusch-Straße" to the "FeelGood" Apartments	2000 m	Not mentioned	To follow where the vehicle is currently (as there is no timetable yet): https://www.wienerlinien.at/eportal3/ep/channelView.do/pageTypeId/66533/channelId/-4400687	1. https://www.ait.ac.at/en/news-events/single-view/detail/5318/?no_cache=1 2. https://de.wikipedia.org/wiki/Autonomer_Bus_(Wien)	
2.	Austria	Digibus© 2017	Koppl (Salzburg area)	April 2017 - November 2017	Navya Arma	Max 11 passengers (11 seated and 0 standing)	Max 16 km/h	Public road with mixed traffic in a rural area.	1400 m	Road mostly lacking road markings, varying inclines, varying mobile network coverage, varying quality of GNSS and correction signals, other road users driving at speeds up to 60 km/h per hour or varying weather conditions	Salzburg Research Forschungsgesellschaft	1. https://www.digibus.at/en/news/ 2. https://etrr.springeropen.com/articles/10.1186/s12544-018-0326-4	
3.	Austria	Digibus© Austria	Koppl (Salzburg area)	2017-2019	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing). Max 9 passengers in test operation	Max 20 km/h	City center	650 m	V2X base stations along the test track (transmission of correction data for high-precision satellite positioning via ITS-G5), communication steles with passengers	Ways of communication with passengers and technical infrastructure	1. https://www.digibus.at/en/news/ 2. https://salzburg.wirtschaftszeit.at/wirtschaftsnews-detail/article/digibusR-austria-mit-neuen-technologien-von-heimischen-unternehmen-an-bord-des-automatisierten-shuttles	
4.	Austria	Digibus© Austria	Wiener Neustadt, Niederösterreich	May 2019 – September 2019	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing). Max 9 passengers in test operation	Max 20 km/h	Wiener Straße between Hauptplatz and St. Peter an der Sperr, at the Lower Austrian State Exhibition “WORLD IN MOTION” in the centre of Wiener Neustadt	560 m	Not mentioned	Salzburg Research Forschungsgesellschaft	https://www.digibus.at/en/news/	
5.	Austria	Digibus© Austria	Teesdorf	13th of November 2019 2019/2020 (without passengers)	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing). Max 9 passengers in test operation	Max 20 km/h	ÖAMTC Verkehrstechnikzentrum Teesdorf	Not mentioned	Not mentioned	Salzburg Research Forschungsgesellschaft	1. https://www.digibus.at/en/news/ 2. https://www.salzburgresearch.at/en/event/digibus-demo-day-at-oeamtc-verkehrstechnikzentrum-teesdorf/	Testing during winter. Non-public tests. Networking meeting for trade visitors and demo rides with the Digibus® including demonstration of newly developed and proven technologies for passenger communication, V2X communication, incident management, capacity management etc.
6.	Austria	Digibus© Austria	Salzburg	September 2019	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing). Max 9 passengers in test operation	Max 20 km/h	Salzburg Ring	Not mentioned	Not mentioned	Salzburg Research Forschungsgesellschaft	1. https://www.digibus.at/en/news/ 2. https://www.salzburgresearch.at/en/presseaussendung/der-selbstfahrende-digibus-faehrt-erstmals-fahrerlos/	Non-public tests without a steward on 19th of September 2019 (supervision from control room only) with 16 volunteers in a test ride

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
7.	Belgium	ALEES (Autonomous Logistics Electric EntitieS for city distribution)	Mechelen	25th of May 2018	Easymile EZ10	Not applicable – transportation of goods in this demo	Not mentioned	City centre (shopping street De Bruul) of Mechelen	Not mentioned	Operating in cyclists/pedestrian area. No infra changes but guided by motorcycle/car (see video in link)	Logistic distribution. Develop possible applications, use cases, technical framework conditions and tests. Fraunhofer IML	1. http://www.easymile.com/alees-project-autonomous-logistics-electric-entitities-for-city-distribution/ 2. https://www.iml.fraunhofer.de/en/news_archiv/alees---autonomous-logistics-electric-entities-for-city-distribu.html 3. https://www.zelfrijdendvervoer.nl/specials/2018/05/30/autonoom-voertuig-biedt-oplossing-voor-winkeldistributie-mechelen/ 4. https://vil.be/project/alees/	VIL report (in Dutch) available in VIL webshop (see link 4 in More information columns)
8.	Belgium	Test Easymile	Formule 1-parcours Francorchamps Spa	2017	Easymile EZ10	Max 12 passengers (6 seated and 6 standing)	11 km/h	On circuit	Not mentioned	Not mentioned	Vias Institute	1. https://www.vias.be/nl/newsroom/eerste-test-in-belgie-van-een-autonome-shuttle-zonder-bestuurder/ 2. https://www.zelfrijdendvervoer.nl/tests/2017/10/03/belgie-test-voor-het-eerst-zelfrijdende-shuttle/	
9.	Belgium	Test Navya	Han-Sur-Lesse	2018	Navya Arma	Max 15 passengers (11 seated and 4 standing)	25 km/h	From the parkinglot to the entrance of the tourist attraction “Caves of Han”.	500 m	Warning signs	Vias Institute	https://www.verkeersnet.nl/smart-mobility/27370/eerste-zelfrijdende-shuttle-op-openbare-weg-van-belgie-rijdt-in-han/	
10.	Belgium	Test Navya	Eigenbrakel	2018	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Max 18 km/h Average 15 km/h	From Leeuw van Waterloo to Hoeve van Hougoumont.	2400 m	Not mentioned	Vias Institute	1. https://www.verkeersnet.nl/smart-mobility/27686/tweede-test-met-shuttle-in-belgie-stuk-uitgebreider/ 2. https://www.vias.be/nl/newsroom/busje-zonder-bestuurder-rijdt-over-een-traject-van-meer-dan-2-kilometer-aan-de-leeuw-van-waterloo-/	
11.	Belgium	Test during salon "Smart City Wallonia"	Marche-en-Famenne	24th of September 2019	2 shuttles from different brands - Navya and Easymile - drove on the same route simultaneously	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	https://mobilit.belgium.be/nl/nieuws/nieuwsberichten/2019/een_nieuwe_stap_genomen_de_ontwikkeling_van_autonome_shuttles	Test organized by Vias institute & FOD Mobility and Transport; both shuttles were coordinated by Bestmile software
12.	Belgium	Health Campus University (VUB)	Brussels	23rd of August 2019 – February 2020	Easymile EZ10	Not mentioned	Average 10-15 km/h	University hospital campus, between the student residences and the main building of the Faculty of Medicine and Pharmacy	Not mentioned	Not mentioned	Free University Brussels (VUB) & ULB	https://www.bouwkroniek.be/article/test-met-zelfrijdende-bus-op-ziekenhuiscampus-in-jette.28745	Research focus on human-machine interaction
13.	Belgium	Zaventem airport shuttle	Zaventem Airport, Brussels	Planned for mid 2020	2getthere GRT vehicle	Max 22 passengers (8 seated and 14 standing)	Max 20 km/h	Between the airport terminal and the cargo business zone and parking areas in mixed traffic	Not mentioned	Fixed route that’s equipped with magnets. Local modifications may be needed to reduce traffic complexity. In mixed traffic	Not mentioned	1. https://www.2getthere.eu/brussels-airport-autonomous-shuttle/ 2. https://www.2getthere.eu/maiden-trip-at-brussels-airport/	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
14.	Belgium	TRIB	Brussels	28th of June – 22nd of September 2019	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Max 10 km/h	In Parc de Woluwe	1800 m 5 stops	Fixed tracking elements (posts) are installed along the route and at the stops with removable platforms	Not mentioned	1. https://smartcity.brussels/news-678--stib-tests-autonomous-vehicles-from-28-6-until-22-9-in-parc-de-woluwe 2. https://easymile.com/stib-trials-the-ez10-autonomous-shuttles-in-parc-de-woluwe-brussels/ 3. https://www.themayor.eu/en/stib-tests-autonomous-buses-in-brussels-region 4. http://www.stib-mivb.be/article.html?l=fr&_guid=00a66cc7-0769-3710-0e97-803f4095ace7	
15.	Denmark	Autonomous mobility	Aalborg Øst	December 2019 – end date not mentioned (planned to run for 2 years)	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Max 18 km/h	On the Astrup Trail connecting residential area with other local transportation. 10 stops	2100 m	Newly designed area with shared road for AV and cyclists. Pedestrians and vehicles are separated.	Aalborg University involved https://avenue.unige.ch/?portfolio=copenhagen	1. https://nordjyske.dk/nyheder/aalborg/aftale--chauffoererne-bliver-smidt-af-busserne/53f6a970-01fd-4157-a1e4-cd7b81e7743d 2. https://www.tv2nord.dk/aalborg/forerlos-busser-skal-laere-finde-vej 3. https://www.tv2nord.dk/aalborg/nu-sker-det-groent-lys-til-selvkoerende-busser	Planned for mid-2018 (delay because of need for permissions, finally obtained in December 2019)
16.	Denmark	Avenue	Nordhavn, Copenhagen	2019 – 2022	Navya Arma	Max 15 passengers (11 seated and 4 standing	Max 25 km/h Average 10-15 km/h (expected)	Circulating withing residential/business area connecting parking/metro in Nordhavn. No exact route available as authorities approval is not received	Not mentioned	Not mentioned	Not mentioned	1. https://h2020-avenue.eu/?portfolio=copenhagen 2. https://h2020-avenue.eu/wp-content/uploads/2019/04/h2020-avenue-deliverable-d2.16_-final.pdf	
17.	Estonia	Marking Estonia's presidency of the Council of the European Union	Tallinn	August 2017	Easymile EZ10	Max 8 passengers	12 km/h	From the city centre to the Kultuurikatel	Not mentioned	Not mentioned	Not mentioned	https://www.calvertjournal.com/articles/show/8713/near-misses-for-tallinns-driverless-buses	
18.	Estonia	Not mentioned	Tallinn	April 2018	Easymile EZ10	Max 8 passengers	12 km/h	1. Between bus terminals in Tallinn's Old Port 2. From Mustamäe to the North Estonian Regional Hospital and Lepistiku	1. 600 m 2. Not mentioned	Not mentioned	Not mentioned	https://www.calvertjournal.com/articles/show/9823/estonias-driverless-buses-are-back-on-the-road-in-tallinn	
19.	Estonia	Sohjoa Baltic project	Tallinn	August 2019 – end date not mentioned	Navya Arma	Max 15 passengers (11 seated and 4 standing	Not mentioned	The route connects the Kadriorg tram stop to Kumu Art Museum and follows Weizenbergi Street to Kumu, then Mäekalda, Koidula and Poska Streets back to Weizenbergi Street	Not mentioned 4 stops	Not mentioned	Not mentioned	https://e-estonia.com/driverless-public-bus-tallinn/	
20.	Finland	CityMobil2	Vantaa	July 2015 – August 2015	Easymile EZ10	Max 10 passengers (6 seated and 4 standing)	Max 13 km/h	In new suburban centre Kivistö, from the housing fair area to Kivistö station (Ring Rail Line)	900 m 2 stops	Route was segregated by fence, clear and identifiable marking of the route (incl. warning signs). There was a 100 m-long tunnel on the route	Part of CityMobil2 project	1. http://www.isinnova.org/wordpress/wp-content/uploads/2016/07/Day1-2-Demonstration_Vantaa-Gilbert_Koskela.pdf 2. https://www.sciencedirect.com/science/article/pii/S0967070X1730286X	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
21.	Finland	Sohjoa Baltic project	Helsinki	June 2019 – September 2019	Navya Arma	Max 11 passengers (11 seated and 0 standing)	Not mentioned	From Vuosaari (Cirrus) metro station to Aurinkolahti beach in Vuosaari district	2500 m 7 stops	Not mentioned	Metropolia University of Applied Sciences	1. http://www.sohjoabaltic.eu/fi/2019/06/26/helsinki-vuosaari-aurinkolahti/ 2. https://www.epressi.com/tiedotteet/logistiikka-ja-liikenne/robottibussi-vie-uimarannalle-helsingin-vuosaaressa.html	
22.	Finland	Sohjoa Baltic project	Estoo	October 2017 – November 2017	Easymile EZ10	Max 10 passengers (6 seated and 4 standing)	Max 12 km/h	Between Otaniemi underground station and campus of Aalto University in Otaniemi business district	700 m 2 stops	At intersections other vehicles were guided with manually controlled traffic lights	Aalto University	https://www.mdpi.com/2071-1050/11/3/588	
23.	Finland	Sohjoa	Helsinki	October 2018 – November 2018	Easymile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 12 km/h	In the Hernesaari district from sauna/restaurant to other restaurants	500 m 4 stops	Not mentioned	Metropolia University of Applied Sciences	1. https://www.sohjoa.fi/ 2. https://www.metropolia.fi/en/about-us/news-and-events/?tx_ttnews%5Btt_news%5D=5936&cHash=9babd6277100ad110cedb6891ddaf03e	
24.	Finland	Sohjoa	Helsinki	April 2018 - end date not mentioned (31st of May 2018 end of Sohjoa project)	Easymile EZ10	Not mentioned	Not mentioned	From the gate of Suvilahti cultural centre via Stadin Panimo to Sörnäisten rantatie	Not mentioned	Along with other traffic and in narrow alleys, without clear road traffic driving lines	Metropolia University of Applied Sciences	1. https://www.sohjoa.fi/ 2. https://forumvirium.fi/en/robot-buses-taking-over-new-areas-in-helsinki-2/	
25.	Finland	Sohjoa	Tampere	November 2016 – end date not mentioned (31st of May 2018 end of Sohjoa project)	Easymile EZ10	Max 8 passengers	11 km/h	The route in the Hervanta district runs from the Tampere University of Technology campus to Shopping Centre Duo	500 m	Not mentioned	A particular focus is placed on the way that self-directed buses find their place within the wider traffic system	1. http://www.tut.fi/interface/articles/2016/2/robot-buses-in-operation-on-campus 2. https://www.sohjoa.fi/	
26.	Finland	Robobus (follow-up from Sohjoa)	Kivikko Helsinki	1. May - November 2018 2. May - November 2019	Navya Arma	Max 8 passengers	18 km/h	1. (2018) From Kivikko's sports park to bus stop Kivikontie. 2 stops. 2. (2019) Circular route by the Redi shopping center to the Isoisänsilta bridge, in in Helsinki Kalasatama	1. 1000 m 2. not mentioned	Not mentioned	Metropolia University of Applied Sciences	1. https://www.helsinkirobobusline.fi/in-english/ 2. https://globenewswire.com/news-release/2018/05/14/1501889/0/en/Self-driving-Bus-on-Helsinki-RobobusLine-Goes-to-Scheduled-Service.html 3. https://forumvirium.fi/en/robotbus2019/	
27.	Finland	Not mentioned	Estoo	September 2019	Gacha (Muji and Sensible4 minibus)	Max 16 passengers (10 seated and 6 standing)	Max 25 km/h	On Nokia's campus	1500 m	Not mentioned	Not mentioned	1. https://www.core77.com/posts/87813/Mujis-Autonomous-Shuttle-Bus-Debuts-in-Finland 2. https://www.sensible4.fi/gacha/ 3. https://www.luxturrim5g.com/new-blog/2019/9/10/the-pilot-for-self-driving-shuttle-bus-gacha-begins	
28	France	CyberMove	Antibes	June 2004	ParkShuttle II	Max 20 passengers	Max 14 km/h 32km/h (demo only)	On the Verdun Avenue	320 m (2x) 3 stops	Not mentioned	Part of CyberMove	http://www.advancedtransit.org/wp-content/uploads/2011/08/ParkShuttle-II-Review-of-the-Antibes-Experiment-A.-Alessandrini-cs..pdf	
29.	France	CityMobil	La Rochelle (Showcase)	18th of September – 28th of September 2008	CRF's (only in this one passengers) and TNO's Advanced city cars, INRIA's and Robosoft's cybercars	Not mentioned	Max 10 km/h	Circuit in city centre; from the quay of the electric "passeur" to the University	800 m 5 stops	A test track was arranged, area was fenced. Other arrangements are not mentioned	Part of CityMobil	1. http://www.citymobil-project.eu/downloadables/Newsletters%20and%20Leaflets/CityMobil_Final_brochure%20Nov-2011.pdf 2. http://www.citymobil-project.eu/downloadables/Deliverables/D1.5.1.6-PU-First%20Advanced%20city%20cars%20showcase%20la%20rochelle-CityMobil.pdf	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
30.	France	CityMobil	La Rochelle (Demo)	2011 (3 months)	Yamaha-based electric prototype cybercars (renamed "Cybus")	Max 5 passengers	Max 10 km/h	Circuit in city centre; from the quay of the electric "passeur" to the University	800 m 5 stops	Wi-Fi transponders were installed at the stops. Operating in pedestrian area	Part of CityMobil	1. http://www.citymobil-project.eu/downloadables/Newsletters%20and%20Leaflets/CityMobil_Final_brochure%20Nov-2011.pdf 2. http://www.isinnova.org/wordpress/wp-content/uploads/2016/07/Day1-6-Demonstration_La_Rochelle-Matthieu_Graindorge.pdf	
31.	France	CityMobil2	Sophia Antipolis	January - March 2016	Easymile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 13 km/h Average 7-8 km/h	Sophia Antipolis business park	950 m 5 stops	Clear and identifiable marking of the route (incl. warning signs), semi-segregated lane w/ pedestrians, bicycles	Part of Citymobil2 project	http://www.isinnova.org/wordpress/wp-content/uploads/2016/07/Day1-3-Demonstration_CASA-Guillaume_Drieux.pdf	
32.	France	CityMobil2	La Rochelle	November 2014 - April 2015	Robosoft Robucity	Max 12 passengers (12 seated and 0 standing)	Max 12 km/h	Tourist route in the Minimes district, partly with vehicle traffic on the route and pedestrians	1710 m 7 stops	Clear and identifiable marking of the route (incl. warning signs) Installation of stations Traffic lights at 6 crossings giving priority	Part of Citymobil2 project	1. http://www.isinnova.org/wordpress/wp-content/uploads/2016/07/Day1-6-Demonstration_La_Rochelle-Matthieu_Graindorge.pdf 2. https://www.sciencedirect.com/science/article/pii/S2352146516302435 3. https://www.sciencedirect.com/science/article/pii/S2352146516302356	
33.	France	EDF Civaux	Civaux	Spring 2016 - not mentioned	Navya Arma	Max 11 passengers (11 seated and 0 standing)	Max 25 km/h	On site of EDF nuclear power plant	Not mentioned	On private road	Not mentioned	1. https://navya.tech/wp-content/uploads/2017/09/NAVYA_Brochure_Print_EN_Website.pdf 2. https://www.busworld.org/articles/detail/2789/autonomous-navya-arma-shuttles-run-on-the-edf-nuclear-powerplant-in-civaux 3. https://www.transdevna.com/services-and-modes/autonomous-mobility/	
34.	France	AVENUE	Lyon	2019 – 2022	Navia Arma	Max 15 passengers (11 seated and 4 standing)	Max 25 km/h	From tram station Décines Grand Large to the Groupama Stadium	1350 m 4 stops	Public road, but prohibited for cars.	Part of Avenue project	1. https://h2020-avenue.eu/portfolio-item/lyon/ 2. https://h2020-avenue.eu/wp-content/uploads/2019/04/h2020-avenue-deliverable-d2.16_-final.pdf	
35.	France	Keolis	Villeneuve d'Ascq	December 2018 – December 2019	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Not mentioned	Route on campus between two metro stations	1400 m 4 stops	Route included a roundabout.	Not mentioned	1. https://www.intelligenttransport.com/transport-news/74340/electric-autonomous-shuttle-france/ 2. https://www.keolis.com/en/media/newsroom/press-releases/keolis-deploys-electric-autonomous-shuttles-two-university-campuses	
36.	France	Intelligent Mobility	Rennes	November 2018 - ongoing	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Not mentioned	For the area around the campus of Rennes 1 university. Route on public road and on a road reserved for soft modes such as cyclists and pedestrians.	1300 m 6 stops	Not mentioned	Not mentioned	1. https://www.keolis.com/en/media/newsroom/latest-news/autonomous-vehicles-start-running-university-campus-rennes 2. https://navya.tech/en/the-keolis-autonoms-shuttles-put-into-service-within-the-rennes-campus-1-on-open-road/	Pilot was initially planned till June 2019

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
37.	France	Intelligent Mobility (continued)	Rennes	November 2019 – end date not mentioned	EasyMile (Gen 3 shuttle) - in addition to Navya Arma	Max 15 passengers (11 seated and 4 standing)	Not mentioned	For the area around the campus of Rennes 1 university. Route on public road and on a road reserved for soft modes such as cyclists and pedestrians.	1300 m 6 stops	Interoperability between different manufacturers under single supervision	Not mentioned	1. https://www.keolis.nl/over-ons/nieuws/keolis-versnelt-ontwikkeling-in-autonome-mobilitei 2. https://easymile.com/easymile-launches-new-ez10-driverless-shuttle-featuring-innovative-safety-architecture-and-enhanced-passenger-experience/	
38.	France	Keolis	Paris	July 2017 - May 2019	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Max 7 km/h	La Defense business district	2000 m	Clear markings of the route	Not mentioned	1. https://www.keolis.com/en/media/newsroom/press-releases/keolis-starts-operation-autonomous-electric-shuttles-defense-paris 2. https://space.uitp.org/initiatives/paris-la-defense-av-france 3. https://innovationorigins.com/self-driving-buses-paris-ends-experiment-after-two-years/	Pilot was initially planned for 6 months
39.	France	Keolis	Paris	April - July 2018	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Max 25 km/h	Within the Roissypôle, the business district of Charles-de-Gaulle Airport, connecting the RER train station to the Groupe ADP's headquarters	700 m	Road infrastructure system that uses traffic signals to communicate dynamically with the shuttles	Not mentioned	1. https://navya.tech/en/the-autonomous-shuttles-are-in-service-at-paris-charles-de-gaulle-airport/ 2. https://navya.tech/en/press/groupe-adp-launches-the-first-trial-of-autonomous-shuttles-at-a-french-airport/	
40.	France	Last mile shuttle	Versailles	10th of December 2018	Easymile EZ10	Not mentioned	Max 10 km/h	From Cité des cadres bus stop to Les Allées des Maronniers	1000 m	Create smart infrastructure by installing sensors for communication with the vehicles	Vedecom Institute: test communication and interactions with various AV's and infrastructure. Research how to modify existing infrastructure for AV's	https://www.adentis.fr/des-navettes-autonomes-a-la-demande-a-versailles/	If successful route will be extended
41.	France	Navly (Keolis)	Lyon	September 2016 - December 2017	Navya Arma	Max 15 passengers (11 seated and 4 standing)	Max 20 km/h	On the banks of the River Saone in the Confluence eco-district, between the shopping centre and the southernmost point of the district	1350 m 5 stops	Not mentioned	Not mentioned	1. https://navya.tech/wp-content/uploads/2017/09/NAVYA_Brochure_Print_EN_Website.pdf 2. https://www.keolis.com/en/media/newsroom/latest-news/navly-first-public-transport-service-by-autonomous-electric-shuttle 3. https://www.keolis.com/en/media/newsroom/latest-news/successful-first-year-world-first-conducted-by-keolis-and-navya	
42.	France	Caisse des Dépôts, Icade and Transdev Part of Caisse des Dépôts demos	Paris	September – December 2017	Easymile EZ10	Max 12 passengers	Not mentioned	Route on the open road in the Icade Park of Orly-Rungis to connect the Augusta, Robert Schuman and Gustave Eiffel stations. For the employees of Rungis Business Park	1250 m	None, uncontrolled intersection	Not mentioned	1. https://www.transdev.com/wp-content/uploads/2018/05/Yearbook-1.pdf 2. http://www.mobilicites.com/011-6457-Transdev-experimente-un-service-de-navette-autonome-en-voie-ouverte-a-Rungis.html	
43.	France	Renault Trucks	Lyon	24th of October – 23rd of November 2016	Navya	Max 15 passengers (11 seated and 4 standing)	Not mentioned	For employees of Renault on industrial site of Saint Priest	Not mentioned	Not mentioned	Not mentioned	1. https://navya.tech/wp-content/uploads/2017/09/NAVYA_Brochure_Print_EN_Website.pdf 2. https://corporate.renault-trucks.com/en/press-releases/2016_14_11_renault_trucks_celebrates_the_100th_anniversary_of_its_lyon_site.html	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
44.	France	TLD - Sorigny	Sorigny	November 2018 – end date not mentioned	Easymile EZ10	Max 12 passengers	25 km/h	TLD's industrial site	1500 m	Not mentioned	Not mentioned	https://www.aviationpros.com/news/12422717/tld-deploys-autonomous-bus	
45.	France	Seine Quayside	Rouen	December 2016 – January 2017	Easymile EZ10	Not mentioned	Not mentioned	Along the banks of the Seine	1600 m	Not mentioned	Not mentioned	https://presse.matmut.fr/file/105200/Dossier-de-presse-Rouen-Normandy-Autonomous-Lab-2017.pdf	
46.	France	Rouen Normandy Autonomous Lab	Rouen	September 2018 – end date not mentioned	I-Crystal (Transdev with Lohr)	Max 16 passengers	Not mentioned	Connection of Rouen's Technopole du Madrillet, tech business cluster, with city's public transportation system	10 000 m in total (3 loops) 17 stops	Not mentioned	Not mentioned	1. http://transdev.ca/services-and-modes/autonomous-mobility/ 2. https://www.zelfrijdendvervoer.nl/tests/2018/06/15/autonome-voertuigen-op-openbare-weg-in-rouen/ 3. https://www.transdev.com/en/press-release/final-testing-before-the-rouen-normandy-autonomous-lab-on-demand-mobility-service-opens-to-the-public/	
47.	France	So Mobility as part of the "Grand Paris de la Mobilité" [Greater Paris Mobility] initiative	Issy-les-Moulineaux	March – April 2017	EasyMile EZ10	Not mentioned	Not mentioned	Circuit in Ile Saint-Germain Park between the car park and the T2 tram station	600 m	Not mentioned	Not mentioned	https://www.transdev.com/en/news-en/inauguration-of-the-autonomous-shuttle-at-issy-les-moulineaux/	
48.	France	SESNA	Saclay	13th of February – 30th of March 2018	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Not mentioned	On the open road at the private Saclay Nuclear Research Centre (CEA) facility	2600 m 7 stops	The route includes intersections and pedestrian crossings and speed ramps	Not mentioned	https://www.ratpdev.com/sites/default/files/annexes/communiques/RATP%20Group%20launches%20experiment%20in%20driverless%20shuttles%20at%20CEA%20Paris%20GB.pdf	
49.	France	Paris-Saclay Autonomous Lab	Saclay	15th of May 2019 – end date not mentioned	I-Crystal (Transdev with Lohr)	Max 16 passengers	Not mentioned	Night collective transportation service for the Saclay Plateau neighborhoods between the Massy station and the Camille Claudel bus station in Palaiseau to serve four stops Massy Palaiseau, Palaiseau Ville, La Vallée, Camille Claudel.	6000 m 4 stops	On public bus rapid transit lanes	The University of Paris-Saclay	1. https://www.transdev.com/en/press-release/paris-saclay-autonomous-lab/ 2. https://media.group.renault.com/global/en-gb/groupe-renault/media/pressreleases/21225791/paris-saclay-autonomous-lab-de-nouveaux-services-de-mobilite-autonome-electrique-et-partagee	
50.	France	RATP Group	Boulogne-sur-Mer	5th of April – 8th of May 2017	EasyMile EZ10	Max 12 passengers	Not mentioned	On Quai des Paquebots	300 m	Not mentioned	Research to obtain passenger opinions with improvement suggestions. Information regarding performance, reliability and operating safety will also be collected.	1. http://www.ratp.fr/en/groupe-ratp/newsroom/mobility-news/driverless-shuttlesratp-group-announces-new-experiments-after 2. https://www.ratpdev.com/en/references/france-boulogne-sur-mer-bus-car	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
51.	France	RATP Group	Paris	23rd of January – 7th of April 2017	EasyMile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 20 km/h	On the Charles de Gaulle bridge between the Gare d'Austerlitz and Gare de Lyon railway stations	250 m	On dedicated lane	Not mentioned	1. http://www.ratp.fr/en/groupe-ratp/newsroom/mobility-news/driverless-shuttlesratp-group-announces-new-experiments-after 2. http://aroundtherings.com/site/A__59718/Title__Very-Promising-Results-for-Autonomous-Shuttles-Experimentation-on-the-Charles-de-Gaulle-Bridge/292/Articles 3. https://www.wired.com/2017/01/tres-dinky-self-driving-shuttle-nudges-paris-future/#	
52.	France	RATP Group	Paris	November 2017 – end date not mentioned	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Max 12 km/h	Between the station Château de Vincennes (metro line 1) and the Parc Floral de Paris (12th district in Paris)	2000 m	Not mentioned	Not mentioned	1. http://www.ratp.fr/en/groupe-ratp/new-types-mobility/new-forms-mobility-adapting-a-changing-society 2. https://www.apur.org/en/our-works/driverless-vehicles-what-their-future-paris (in maps to download)	
53.	France	Smart City	Toulouse	January – May 2018	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Average 13-14 km/h Average 7-8km/h (taking into consideration the duration of the intermediary stop)	Following Allees Jules Guesdes from « Palais de justice » Metro/Tram station to Grand-Rond public garden	850 m 3 stops	In pedestrian zone	Not mentioned	https://www.polisnetwork.eu/wp-content/uploads/2019/06/4a_malicet.pdf	
54.	France	Smart City	Pibrac	14th of June – 5th of September 2017	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Average 6.3 km/h	City centre (Esplanade Sainte Germaine)	340 m 3 stops	Not mentioned	Survey on users' opinion	https://www.polisnetwork.eu/wp-content/uploads/2019/06/4a_malicet.pdf	
55.	France	Transdev	Verdun	29th of May – 11th of August 2018	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Max 14 km/h	City centre	1400 m 5 stops	On open road	Not mentioned	1. https://www.transdev.com/en/news-en/discover-an-autonomous-city-center-shuttle-in-verdun-during-the-summer/ 2. https://www.cerema.fr/fr/centre-ressources/newsletters/transflash/transflash-ndeg-414-nov-2018/verdun-bilan-positif-navette-autonome	
56.	France	Transdev	Reims	2nd of May – 30th of June 2018	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	10 km/h	Between the "Bezannes Champagne Ardennes TGV" train station and the "Gare Champagne TGV" tram station located on line B of the transport network Citura	400 m	On steep slope	Users' perceptions by Transdev	1. https://www.citura.fr/fr/navette-autonome/1010 2. https://www.transdev.com/en/news-en/reims-when-shared-autonomous-mobility-facilitates-intermodal-transport/ 3. https://www.construction21.org/france/infrastructure/fr/service-de-transport-autonome-a-reims.html	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
57.	France	ISFM	Velizy-Villacoublay	March 2019 – end date not mentioned	MILLApod (by Intelligent Systems For Mobility, ISFM)	Max 6 passengers (6 seated and 0 standing)	Max 30 km/h	From the Mozart and Le Clos neighborhoods to the R. Wagner T6 station	4000 m	In mixed traffic alongside motorists, bicycles, trams, etc. The road network will be equipped with sensors, allowing MILLA to detect priorities on the right, traffic lights, pedestrian crossings. It can be called via application	Users' opinion survey https://www.velizy-villacoublay.fr/actualite/navette-autonome-participez-a-l-experimentation	1. https://www.velizy-villacoublay.fr/actualite/millapod-navette-autonome 2. https://pole-moveo.org/pme/la-navette-autonome-milla-circule-desormais-a-velizy/	
58.	France	NASC (autonomous shuttle without driver)	Velizy-Villacoublay	1. 26th of June 2018 (for 3 weeks) 2. September 2018	EasyMile EZ10	Max 12 passengers (6 seated and 6 standing)	Max 10 km/h	Villacoublay Air Base 1. Test rides 2. To transport airmen from operational zones to the living zone	Not mentioned	Not mentioned	Not mentioned	https://www.defense.gouv.fr/actualites/communaute-defense/une-navette-autonome-sur-la-base-aerienne-de-villacoublay	
59.	France	TOTAL	Dunkirk	May 2018 – end date not mentioned (Planned for 5 years)	Navya	Max 14 passengers	Max 20 km/h	In the international training site Oléum of TOTAL between the guards' post and the training centre	800 m	In industrial environment	Not mentioned	1. https://www.lavoixdunord.fr/493289/article/2018-11-22/sur-la-voie-des-mobilites-nouvelles-total-fait-rouler-une-navette-autonome 2. https://www.travelnet.fr/focus/824-la-navette-autonome-navya-lancee-sur-le-site-de-total-a-dunkerque 3. https://www.lesechos.fr/2018/05/berthelet-parie-sur-le-transport-vert-990628	Pilot planned for 5 years
60.	Germany	Continental	Frankfurt	17th of April – 19th of April 2018	CUbE (Continental Urban Mobility Experience)	Not mentioned	Not mentioned	On the campus of University of Applied Sciences	Not mentioned	Not mentioned	Share knowhow among Continental, Easymile and VGF. Determine future requirements for AV's and usage models	1. https://www.continental-automotive.com/Landing-Pages/CAD/CUbE/Driverless-Mobility/Driverless-Mobility 2. https://www.continental.com/en/press/press-releases/cube-technologies-74492	
61.	Germany	HEAT project (Hamburg Electric Autonomous Transportation)	Hamburg	Phase 1: 2019-2020 (mid-2020 with passengers and steward) Phase 2: 2021 (without steward)	IAV vehicle	Max 10 passengers	Not mentioned Design speed 50 km/h	In Hamburg's HafenCity 1. Ring route: along the streets Am Dalmannkai, Großer Grasbrook, Am Sandtorkai and Am Sandtorpark. 2. On Am Kaiserkai and drive directly past Hamburg's new landmark Elbe Philharmonic Hall	1840 m 5 stops	Supplementary intelligent infrastructure along its route, including sensors and a digital communications system to communicate with control room and surrounding. There are 6 traffic lights and 9 intersections.	German Aerospace Center	1. https://www.hamburg-news.hamburg/en/renewable-energy/heat-project-launches-hamburg/ 2. https://www.hamburg.com/business/its/12778724/heat/ 3. https://www.hochbahn.de/hochbahn/hamburg/en/home/projects/expansion_and_projects/project_heat 4. https://itseuropeancongress.com/2019/07/31/heat-hamburg-electric-autonomous-transportation/	
62.	Germany	I-AT Interreg Deutschland Nederland (2017-2020)	1. Airport Weeze, Germany 2. Aachen (Germany)-Vaals (The Netherlands)	1. 21st of February 2019 – end date not mentioned 2. End of 2019	1. Easymile EZ10 from WEpod project 2. CM Mission	1. Not mentioned 2. Max 15 passengers	Not mentioned	Multiple locations - starting at Airport Weeze from departure hall to the parkinglot and airport hotel	Not mentioned	Not mentioned	TU Delft	1. https://www.i-at.nl/ 2. https://www.deutschland-nederland.eu/nl/project/i-at-2/ 3. http://i-at.nl/iatnl/Living-Lab-Weeze-shuttle-voor-passagiers 4. http://i-at.nl/iatnl/Living-Lab-Aken-Vaals-openbaar-vervoer-shuttle	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
63.	Germany	Südwestdeutsche Landesverkehr-AG (SWEG)	Lahr, Baden Württemberg	14th of July – 30th of September 2018	Easymile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 15 km/h	From Otto-Hahn-Straße via Mauerweg and Schwarzwaldstraße to the roundabout at Otto-Hahn-Straße	1500 m 2 stops	Mixed traffic, speed limited to 30 km/h valid between 9 am and 4 pm (when the shuttle is operating)	Not mentioned	1. http://www.easymile.com/ez10-becomes-the-first-autonomous-shuttle-to-operate-on-public-roads-in-lahr-germany/ 2. https://vm.baden-wuerttemberg.de/de/ministerium/presse/pressemitteilung/pid/erste-autonom-fahrende-bus-im-oeffentlichen-strassenverkehr-rollt-in-lahr/ 3. https://www.sciencedirect.com/science/article/pii/S1361920919301944	
64.	Germany	NAF Bus	Schleswig-Holstein	1. August 2018 2. May 2019	Easymile EZ10	Not mentioned	Not mentioned	1. GreenTEC Campus Enge-Sande (private grounds) 2. Public roads in the rural district Nordfriesland and public roads on North Sea island Sylt, Germany	1500 m	In mixed traffic conditions, within the business park	Gain insight into user experience and behavior, individual and social acceptance, risk-benefit considerations by consulatancy EurA. Online opinion poll by Christian-Albrechts-Universität zu Kiel	1. http://www.easymile.com/ez10-driverless-shuttle-begins-operation-in-greentec-campus-germany/ 2. https://www.naf-bus.de/ 3. https://www.eura-ag.de/2019/10/24/the-autonomously-driving-electric-bus-current-status-of-our-project/	Expansion to Dithmarschen planned
65.	Germany	Olli	Berlin	December 2016 – April 2017	Olli	Not mentioned	Max 10 km/h Average speed 8 km/h	EUREF Campus, Berlin Schöneberg.	700 m 3 stops	Warning signs, shuttle has right of way, overtaking the shuttle was not allowed and 10m distance from shuttle was required. In mixed traffic (pedestrians, cyclists, occasional cars and trucks)	User acceptance. Sina Nordhoff, TU Delft & Innovation Centre for Mobility and Societal Change.	1. https://archiv.berliner-zeitung.de/berlin/verkehr/-olli--erstmals-ist-in-berlin-ein-autonom-fahrender-bus-unterwegs-25205714 2. https://www.deutschlandfunk.de/verkehr-berliner-mobilitaetszentrum-innoz-wird-aufgegeben.769.de.html?dram:article_id=447601 3. https://euref.de/euref-campus/#mobilitae 4. https://www.researchgate.net/publication/319253225_User_acceptance_of_automated_shuttles_in_Berlin-Schoneberg_A_questionnaire_study 5. https://www.sciencedirect.com/science/article/abs/pii/S1369847818304327 6. https://www.researchgate.net/publication/334803765_Passenger_opinions_of_interactions_with_an_automated_vehicle_An_accompanied_test_ride_study 7. https://www.researchgate.net/publication/317497564_User_Acceptance_of_Driverless_Shuttles_Running_in_an_Open_and_Mixed_Traffic_Environment	
66.	Germany	Pole Position	Berlin	May 2016 – April 2019	Easymile EZ10	Not mentioned	Not mentioned	EUREF Campus	Not mentioned	Not mentioned	High-power inductive energy collector with full automated recharging combined with on-demand use and demonstration of the vehicle.	https://www.emo-berlin.de/de/projekte/pole-position/	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
67.	Germany	Ioki	Bad-Birnbach	25th of October 2017 – still in operation	Easymile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 15 km/h	From town centre to the thermal baths on public roads	700 meters Since October 2019 1400 m	Variable traffic sign system: when bus is detected, there is a change of traffic signs from 50 km/h to 30 km/h and the other vehicles must slow down. Only then the bus may drive 500 meters on the highway	Not mentioned	1. https://ioki.com/en/uncategorized/first-autonomous-vehicle-on-german-public-roads/ 2. https://www.badbirnbach.de/en/stories/autonomous-minibus 3. https://www.br.de/nachrichten/bayern/neue-strecke-fuer-fahrerlose-elektrobusse-in-bad-birnbach,ReBIt7z	
68.	Germany	AutoNV_OPR	Wusterhausen/ Dosse, Ostprigtnitz-Ruppin	End of 2017 – 30th of June 2020	Easymile EZ10	Max 5 passengers (5 seated and 0 standing)	Not mentioned	From historic town centre to trainstation and supermarkt. Possible extension to Northern part of the town.	3500 m	Mixed traffic	TU Berlin (traffic aspects) & TU Dresden (acceptance and economic/social aspects)	1. https://www.autonv.de/ 2. https://tu-dresden.de/bu/verkehr/ivs/vpsy/forschung/projekte_aktuell 3. https://innovationorigins.com/self-driving-buses-paris-ends-experiment-after-two-years/	
69.	Germany	See-Meile	Berlin	August – end of 2019	Easymile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 15 km/h	Route between Alt-Tegel, Am Tegeler Hafen, Wilkestraße and Medebacher Weg	1200 m	Parking space and charging infrastructure	Acceptance study by Ioki	1. https://www.iamexpat.de/expat-info/german-expat-news/try-berlins-new-driverless-bus-free 2. https://innovationorigins.com/project-see-meile-berlin-experiment-with-self-driving-bus-on-public-roads/ 3. https://ioki.com/en/news-en/autonomous-bus-in-the-streets-of-berlin/	
70.	Germany	Projekt Stimulate	Berlin	Summer of 2017 – spring of 2020	Navya & Easymile EZ10	Max 11 passengers (Navya) Max 6 passengers (EZ10)	Max 12 km/h	1. Route on campus Charité Mitte 2. Two routes on campus Virchow Klinikum	1. 1200 m 2. 800 m and 1500 m	Mixed traffic	Acceptance and practical implications. City of Berlin in collaboration with Charité and the Institute of Medical Sociology and Rehabilitation Science	1. https://www.wir-fahren-zukunft.de/wp-content/uploads/2017/09/PM_Stimulate.pdf 2. https://www.wir-fahren-zukunft.de/en/2018/06/13/driverless-buses-take-to-the-streets/	
71.	Germany	Transdev	Leipzig	23th of May – 25th of May 2018	EasyMile EZ10	Max 12 passengers	Max 20 km/h	During the International Transport Forum Summit 2018 Route along the water basins (Merkurbrunnen) leading from the vicinity of the tram line N°16 “Messegelände” stop to the Congress Centre Leipzig main entrance hall	200 m	Dedicated track	Not mentioned	https://www.transdev.com/en/press-release/transdev-presents-its-autonomous-transport-service-at-the-international-transport-forum-itf-2018-summit/	
72.	Greece	CityMobil2	Trikala	November/ December 2015 - February 2016	Robosoft Robucity	Max 12 passengers	Max 13 km/h	Trikala city centre, on a dedicated lane alongside different transport modes	2400 m 9 stops	Clear and identifiable marking of the route (incl. warning signs)	Part of Citymobil2 project	1. http://www.isinnova.org/wordpress/wp-content/uploads/2016/07/Day1-5-Demonstration_Trikala-Odisseas_Raptis.pdf 2. https://ieeexplore.ieee.org/document/7995779 https://www.sciencedirect.com/science/article/pii/S1369847816301620	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
73.	Ireland	Smart Docklands	Dublin	21st of September – 22nd of September 2018	EasyMile EZ10	Max 15 passengers	Max 25 km/h	From Dublin convention centre to Arena on North Wall Quay	1000 m 4 stops	Designated route	University College Dublin	1. http://www.EasyMile.com/ez10-debuts-as-first-driverless-shuttle-in-ireland/ 2. https://www.rte.ie/news/2018/0921/995125-driverless-cars/ 3. https://www.rte.ie/news/2018/0921/995125-driverless-cars/ 4. https://osf.io/preprints/socarxiv/z2afc 5. http://mural.maynoothuniversity.ie/9353/1/LH-Interfaces-2018.pdf	
74.	Italy	CityMobil2	Oristano	July – August 2014	Robosoft	Max 12 passengers	Max 12 km/h	Seafront of Torre Grande	1300 m 5 stops	Clear and identifiable marking of the route (incl. warning signs)	CityMobil2 project Experiments concerned vehicle performance, environmental impact application in pedestrian zones and people acceptance	http://www.fotovoltaicosulweb.it/guida/primi-autobus-senza-conducente-a-oristano-city-mobil-2.html	
75.	Italy	ITC-ILO	Turin	January – May 2020	Olli	Max 12 passengers	Max 25 km/h	ICT-ILO campus	Not mentioned	Not mentioned	ITC-ILO University of Turin	https://www.sustainable-bus.com/smart-mobility/olli-debuts-in-italy-turin-deploys-the-3d-printed-driverless-shuttle/	Printed in 3D technology Fully electric
76.	Luxembourg	Avenue	Pfaffenthal	September 2018 – March 2019	Navya	Max 18 passengers (14 seated and 4 standing)	Max 25 km/h	From Pfaffenthal lift to the cable-car and the Val des Bons Malades Cemetery	1000 m	Not mentioned	Avenue project	1. http://luxembourg.public.lu/en/actualites/2018/09/21-cityshuffle/index.html 2. http://www.revue.lu/der-pionier-bus/ 3. https://h2020-avenue.eu/content/luxembourg-site-description	
77.	Luxembourg	Avenue	Contern	16th of September – 22nd of September 2018	Navya	Max 18 passengers (14 seated and 4 standing)	Max 18 km/h	Connection from the train station to the industrial zone	3500 m	Not mentioned	Avenue project	1. https://h2020-avenue.eu/content/luxembourg-site-description 2. https://delano.lu/d/detail/news/contern-test-bed-driverless-bus/190494	
78.	Norway	Applied Autonomy	Svalbard	21st of March 2019	EasyMile EZ10	Not mentioned	Not mentioned	Airport area (Not specified)	Not mentioned	None, integrated in existing infrastructure	Applied Autonomy	1. https://EasyMile.com/first-ever-autonomous-vehicle-operates-in-arctic-circle/ 2. https://www.youtube.com/watch?v=jfTwpttVCY0	First autonomous vehicle operating in the Arctic Circle
79.	Norway	Fabulos	Gjesdal	Planned for spring 2020	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Fabulos project Forum Virium Helsinki	https://forumvirium.fi/en/fabulos-brings-self-driving-buses-to-the-streets-of-europe/	Procurement process in 3 phases: 1. Feasibility study, 2. Development of well-defined prototypes, 3. Verification and comparison of the first end products in real-life situations.
80.	Norway	Gjøvik Municipality/ NTNU/ Applied Autonomy	Gjøvik	20th of July – October 2018	EasyMile EZ10 Gen2	Max 6 passengers	Max 13 km/h	From Fjellhallen to centre of Gjøvik	3 stops 900m	None, integrated in existing infrastructure	Not mentioned	1. https://www.gjovik.kommune.no/nyheter/forerlos-buss-i-gjovik-sentrum/ 2. https://bussmagasinet.no/?p=11283 3. https://space.uitp.org/initiatives/autonomous-city-bus-av-pilot-gjovik-norway	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
81.	Norway	Kolumbus/ Forus PRT/ Autobus	Stavanger	12th of June – 30th of November 2018	EasyMile EZ10	Max 6 passengers	Max 12 km/h	Forus Næringspark	1200m	None, integrated in existing infrastructure	Institute of Transport Economics (TØI)	1. https://sciencenorway.no/cars-and-traffic-forskningno-norway/driverless-busses-coming-to-a-street-near-you/1443619 2. https://www.toi.no/autobus/	During the test the speed of the vehicle increased to 15 km/h
82.	Norway	OBOS/Acando	Fornebu	June –August 2018	EasyMile EZ10	Max 6 passengers	Max 12 km/h	From Fornebu S and up to Storøyodden	1500m	None, integrated in existing infrastructure	Evaluation by Ruter	1. https://norwaytoday.info/news/self-driven-bus-tested-fornebu/ 2. https://www.obos.no/privat/samfunnsansvar/obos-innovasjon/norges-forste-selvkjorende-badebuss 3. https://www.toi.no/autobus/	
83.	Norway	Ruter/ Autonomous mobility/ Autobus	Oslo Akershusstranda	May 2019 – Oktober/November 2019	Navya Arma	Max 11 passengers	Max 18 km/h	Kontraskjæret - Vippetangen	1100m	None, integrated in existing infrastructure	Evaluation by Ruter; Institute of Transport Economics (TØI)	1. https://ruter.no/en/about-ruter/reports-projects-plans/autonomous-vehicles/ 2. https://norwaytoday.info/news/oslos-first-bus-route-with-driverless-bus-opned/ 3. https://www.ovmagazine.nl/wp-content/uploads/2019/05/NO_Report_RUTER_Frokostmoede-410-gecomprimeerd.pdf 4. https://www.toi.no/autobus/	Self-driven buses are electric; non-public tests without steward autumn 2019 Max passenger capacity includes the steward
84.	Norway	Ruter/ Autonomous mobility/ Autobus	Oslo Ormøya	November 2019 – end date not mentioned	Navya Arma	Max 8 passengers	Max 18 km/h	Bækkelaget - Malmøya	1400m	None, integrated in existing infrastructure	Evaluation by Ruter; Institute of Transport Economics (TØI)	1. https://ruter.no/en/about-ruter/reports-projects-plans/autonomous-vehicles/ 2. https://www.toi.no/autobus/	
85.	Norway	Sohjoa Baltic/Testsite Kongsberg/ Autobus	Kongsberg	Phase 1: 15th of October – 26th of November 2018 Phase 2: 2nd of December 2018 – 23th of April 2019 Phase 3: 23th of April - onward Phase 3.1: 13th of October 2019 - onward	2 EasyMile EZ10 Gen2 EZ10 Gen3 starting in January 2020	Max 6 passengers	Max 16 km/h	To Teknopark: Knutepunktet - Tråkka -Rådhuset - Bussedalen - Svinegropa–Tekno logiparken. From Teknopark: Teknologiparken-Svinegropa – Busse dalen - Rådhuset - Gågata – Knute punktet	Phase 1: 900 m Phase 2: 2000 m Phase 3: to Technology Park 4400 m; Phase 3.1: 5500 m	None, integrated in existing infrastructure	Institute of Transport Economics (TØI), Forum Virum Helsinki	1. https://www.sohjoabaltic-kongsberg.com/kongsberg-introduces-driverless-minibuses/ 2. https://www.brakar.no/prosjekter/testprosjekt-med-selvkjorende-buss-i-kongsberg/ 3. https://www.uitp.org/news/applied-autonomy-operating-autonomous-shuttles-norway 4. https://www.toi.no/autobus/	2 vehicles in operation 4 hours every day; service integrated with national travel planner Entur and Brakar travel planner & Brakar real-time viewer of the buses; commercial operation with adult ticket requirements, certain groups (e.g. children) travel for free
86.	Norway	CityMobil	Trondheim	August 2009	INRIA	Max 6 passengers	Not mentioned	From Elgeseter bridge following Håkon Jarls gate (pedestrian and cyclists street) to hospital entrance	170 m 3 stops	Segregated track (fenced area)	Part of CityMobil project	https://www.youtube.com/watch?v=K61iDr9fYGE	
87.	Poland	Sohjoa Baltic	Gdansk	September 2019	EasyMile EZ10	Max 12 passengers	Not mentioned	From the stop at the entrance to the ZOO, through an intermediate stop at the car park to the final stop at Spacerowa Street	Not mentioned 3 stops	Not mentioned	Part of Sohjoa Baltic project	1. http://www.sohjoabaltic.eu/en/2019/12/12/gdansk-pilot-2019-on-video/#partners 2. http://www.sohjoabaltic.eu/en/2019/09/11/gdansk-pilot-started/ 3. https://www.themayor.eu/mt/starting-today-gdansk-is-testing-an-autonomous-electric-bus	Max passenger capacity includes the steward
88.	Spain	Citymobil	Castellón	October 2008	Not mentioned	Not mentioned	Not mentioned	Connection between Castellòn and Benicassim	40000 m	Dedicated lanes	Citymobil project	http://www.citymobil-project.eu/site/en/SP1%20Castellon.php	Hybrid system of guided bus/tramway
89.	Spain	Citymobil2	Donostia/ San Sebastian	April – June 2016	Robosoft/ EasyMile	Max 10 passengers	Max 30 km/h In operation 10 km/h	Miramon Paseo Mikeletegi	1200 m 6 stops	Major infrastructural changes: car parking facilities, limit the max speed to 30 km/h, change traffic direction	Citymobil2 project	http://www.autonet2030.eu/wp-content/uploads/2016/11/12_AutoNet2030_CityMobil2.pdf	1968 trips, 2362 km distance, 1918 passengers

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
90.	Sweden	Project S3 – Shared Shuttle Services	Göteborg	April – October 2019	Navya (operator Autonomous Mobility)	Max 9 passengers	Average 11 km/h	Two distinct routes: 1. Johanneberg, Chalmers University of Technology campus 2. First/last-mile parking option for Lindholmen Science Park	1200 m	Construction and changes on the route itinerary	RISE Viktoria (mentioned in their in newsletter 462). Associated research: User acceptance, open innovation, business models and road maps	1. https://www.gp.se/ekonomi/här-kan-göteborgarna-åka-självkörande-buss-1.14717037 2. https://space.uitp.org/initiatives/s3-shared-shuttle-av-pilot-gothenburg-sweden	
91.	Sweden	Self-driving buses in Västerbottensby	Varuträsk	September 2019 – September 2020	EasyMile	Not mentioned	Not mentioned	Rural area	Not mentioned	Not mentioned	Swedish Transport Association/ Skellefteå municipality/ Vinnova	https://www.bussmagasinet.se/2019/04/sjalvkorande-bussar-i-vasterbottensby/	
92.	Sweden	Scania & Nobina	Stockholm	Planned for 2020	Scania Citywide LF electric, full size, bus	Max 80 passengers (25 seated and 55 standing)	Max 24 km/h	On regular bus route from residential area Barkarby to metro station in downtown Stockholm	Phase 1: 1000 m Phase 2: 5000 m 4 stops	Dedicated lane	Not mentioned	1. https://www.sustainable-bus.com/news/scania-partners-with-nobina-for-autonomous-bus-trial-in-stockholm/ 2. https://www.ericsson.com/en/internet-of-things/trending/driverless-buses-in-stockholm-sweden 3. https://www.bussmagasinet.se/2019/04/internationellt-pris-till-barkarbys-sjalvkorande-bussar/	
93.	Sweden	CityMobil2	Stockholm	25th of April – 29th of April 2016	EasyMile EZ10	Max 12 passengers	Not mentioned	Ericsson, Nobina Technology and Kista Science City	Not mentioned	Not mentioned	Not mentioned	https://www.drivesweden.net/evenemang/kista-mobility-week	
94.	Sweden	Drive Sweden	Stockholm	January - June 2018	EasyMile EZ10	Max 12 passengers	Max 20 km/h	In Kista Science City between Victoria Tower and Kista Galleria, with a stop on the road outside of the Time building (Kistagången 16)	1500 m	Not mentioned	Not mentioned	1. http://www.urbanictarena.se/smart-self-driving-buses-start-operating-kista-today/ 2. https://www.thelocal.se/20171227/stockholm-gets-scandinavias-first-driverless-buses-on-public-road	
95.	Sweden	Volvo automated bus (trial)	Göteborg	November 2019	Volvo, full size buses	Not mentioned	Not mentioned	Automated ride (and parking) between the parking bay and several different workstations (such as cleaning, servicing, and electric charging) at a depot used by bus operator Keolis	Not mentioned	Not mentioned		1. https://dutchmobilityinnovations.com/spaces/86/dutch-mobility-innovations/articles/news/29750/europe-s-first-self-driving-buses-demonstrated 2. https://hitecher.com/news/volvo-tests-self-driving-bus-prototype-in-real-conditions	
96.	Switzerland	Citymobil2	Lausanne	April – August 2015	EasyMile EZ10	Not mentioned	Max 12 km/h	Campus EPFL West Region, between metro station and campus/working sites Pedestrian area	1500 m 6 stops	Clear and identifiable marking of the route (incl. warning signs)	Citymobil2 project	https://www.domusweb.it/en/news/2015/11/17/citymobil2_at_epfl.html	4447 trips, 6970 km distance, 7000 passengers

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
97.	Switzerland	AMoTech – Route 12 project	Neuhausen	March 2018 – end of 2019	Navya	Not mentioned	Not mentioned	Connect the centre of Neuhausen with Schlössli Wörth at the Rhine Falls basin	2000 m	None, integrated in existing infrastructure	Conducted by ISTP at ETH: research on public perceptions	1. https://www.amotech.ch/en/showroom/projekt-linie-12 2. https://www.amotech.ch/pdfdocs/nahverkehrs-praxis%E2%80%93ausgabe7_8-2018-interview.pdf 3. https://www.swisstransitlab.com/en 4. https://www.amotech.ch/en/references 5. https://www.research-collection.ethz.ch/handle/20.500.11850/282577 6. https://www.semanticscholar.org/paper/How-technology-commitment-affects-willingness-to-a-Wicki-Guidon/2d81e57abc73317a423f0ed46fce8d04ebb5d3c8 7. https://www.research-collection.ethz.ch/handle/20.500.11850/339708	
98.	Switzerland	Meyrin Shuttle Bestmile Avenue	Geneva	June 2018 – end date not mentioned	Navya	Max 11 passengers	Max 25 km/h	First/last mile solution for Meyrin train station, connecting three tram stops	2100 m 3 stops	None, integrated in existing infrastructure	AVENUE project	1. https://bestmile.com/tpg-launches-first-autonomous-service-in-geneva-managed-by-bestmile-platform/ 2. https://h2020-avenue.eu/portfolio-item/geneva/	Two candidates for route expansion in 2019: 1. Belle- Idée hospital site (around 10 to 35 stops); 2. eco-neighbourhood of Verges
99.	Switzerland	Pilot Zug	Zug	25th of March 2017 - end of 2019	EasyMile EZ10	Max 9 passengers (6 seated and 3 standing)	Max 20 km/h	From Zug railway station to Technology cluster Zug.	Not mentioned	None, integrated in existing infrastructure	Mobility	https://www.mobility.ch/en/news/self-driving-vehicles/	
100.	Switzerland	Smartshuttle by PostBus	Sion	June 2016 – end date not mentioned	Navya	Max 11 passengers	Max 20 km/h	Route through the city centre.	3000 m	None, integrated in existing infrastructure. Operational in open roads and pedestrian zone. Encounter traffic lights, intersections roundabouts and mixed traffic	Research if AV's in public areas give customer added value, if it is possible to operate AV's in public areas (pedestrian and car-free zones) or on company premises	1. https://www.postauto.ch/en/testing-sion 2. https://www.swissinfo.ch/eng/on-board_sion-driverless-bus-service-to-be-expanded/43604204 3. https://space.uitp.org/initiatives/smartshuttle-sion-av-switzerland 4. https://ieeexplore.ieee.org/document/8688840 5. https://www.researchgate.net/publication/316615482_On_the_Road_with_an_Autonomous_Passenger_Shuttle_Integration_in_Public_Spaces	Route was 1500 m in the beginning and was extended to 3000m in February 2018
101.	Switzerland	AmoTech – Trapeze operations Bernmobil	Bern	July 2019 – planned to run for 2 years	EasyMile	Not mentioned	Max 30 km/h	Between the Bärenpark and the funicular "Marzilibahn"	2000 m 6 stops	Not mentioned	Not mentioned	1. https://www.trapezegroup.eu/news/media-release-trapeze-operations-control-system-is-ready-for-self-driving-v 2. https://www.amotech.ch/en/references	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
102.	Switzerland	Transports publics fribourgeois (TPF)/ Marly Innovation Center (MIC)/ Municipality of Marly/ Agglomeration of Fribourg/ State of Fribourg	Fribourg	August – November 2017	Navya	Max 11 passengers	Max 25 km/h	From Marly Innovation Center to Fribourg Public Transport network.	1300 m	Not mentioned	Not mentioned	1. https://www.swissinfo.ch/eng/first-autonomous-transport-service-in-switzerland-inaugurated/43541214 2. https://www.tpf.ch/en/-/une-navette-automatisee-pour-desservir-le-marly-innovation-center	Fixed headway (7 mins) In-vehicle time of 7 mins
103.	Switzerland	Bestmile in collaboration with Transports de la région Morges Bière Cossonay	Cossonay	July – December 2017	Navya and Bestmile	Not mentioned	Not mentioned	From the funicular station to key attractions in the old town. Two different loops	1700 m 8stops	Part of existing PT network. Open streets and roads.	Address the challenge of first/last mile connectivity	https://bestmile.com/the-transports-de-la-region-morges-biere-cossonay-mbc-to-partner-with-bestmile-to-operate-a-unique-autonomous-shuttle-service-in-the-city-center-of-cossonay-switzerland/	
104.	The Netherlands	Appelscha	Appelscha	13th of September – 31st of October 2016	EasyMile EZ10	Max 6 passengers (6 seated and 0 standing)	Max 15 km/h	From visitor centre Staatsbosbeheer to city of Appelscha.	2500 m	On bicycle track. Bicycle track got priority at crossings during the pilot. Warning signs	STAD-project (casestudy)	https://www.mdpi.com/2032-6653/9/1/15	
105.	The Netherlands	Drimmelen	Drimmelen	August – September 2019	Navya	Max 8 passengers (8 seated and 0 standing)	Max 15 km/h	From bus stop to parking lot and harbour of Drimmelen	Not mentioned	Mixed traffic	Not mentioned	https://zelfrijdendeauto.com/gemeente-drimmelen-investeert-in-zelfrijdende-buurtbus/	
106.	The Netherlands	ESA-ESTEC	Noordwijk	October 2019 - 2021	Navya	Max 8 passengers (8 seated and 0 standing)	Max 15 km/h	2 phases: first on the private property of ESA-ESTEC. Second phase the route will be extended to public roads	Not mentioned	Mixed traffic	Not mentioned	https://www.omroepwest.nl/nieuws/3732849/ESTEC-personeel-met-zelfrijdende-shuttles-naar-het-werk	
107.	The Netherlands	Haga shuttle	Den Haag	Summer of 2019 – end date not mentioned	Navya	Max 8 passengers (8 seated and 0 standing)	Max 15 km/h	From busstop 'Leyweg' to the Haga Hospital.	1000 m	Lines are applied for the vehicle to navigate and to create a lane for the vehicle. Warning signs will be placed including warnings on the road surface. Part of the route is designated lane.	TU Delft (research questions not defined yet)	1. http://thefuturemobility.network/den-haag-zelfrijdende-minibus/ 2. https://www.ovpro.nl/bus/2019/01/17/htm-stuurt-zelfrijdende-bus-in-2019-de-weg-op/?gdpr=accept	
108.	The Netherlands	RiviumPark Shuttle	Rotterdam	2005 - still in operation	2getthere	Max 20 passengers (8 seated and 12 standing)	Max 32 km/h	From metro station to business park	1800 m	Dedicated track with regulated crossings	STAD-project (case study and master thesis about passenger perception)	1. https://www.researchgate.net/publication/329782024_Driverless_electric_vehicles_at_Businesspark_Rivium_near_Rotterdam_the_Netherlands_from_operation_on_dedicated_track_since_2005_to_public_roads_in_2020 2. https://www.semanticscholar.org/paper/Riding-a-self-driving-bus-to-work%3A-Investigating-on-Dekker/3acb428836af7d1407514e1706c3bb6a318b8460	No steward on board
109.	The Netherlands	Scheemda	Ommelander Ziekenhuis, Scheemda	6th of August 2018 – end of 2019	Navya	Max 8 passengers (8 seated and 0 standing)	Max 15 km/h	From bus stop 'Molenstraat' to the Ommelander Hospital.	1500 m	Operating on extra wide (4 m) bicycle lane	Not mentioned	https://www.autonoomvervoernoord.nl/wp-content/uploads/2018/08/Veel-gestelde-vragen-zelfrijdende-shuttle-Scheemda.pdf	If successful permanent implementation is considered

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
110.	The Netherlands	Mercedes-Benz Future Bus	Schiphol airport – Haarlem	18th of July 2016	Mercedes-Benz Future Bus	Not mentioned	50 km/h Max 70 km/h	On bus lane between Schiphol airport and Haarlem	Not mentioned	Sections of the bus lane between Schiphol Airport and Haarlem are closed off. At several stretches of the route, particularly at intersections, the bus will take the public road. Communication between the bus and 19 traffic lights. Bus is given priority	Not mentioned	1. https://www.government.nl/latest/news/2016/07/28/successful-test-with-first-self-driving-bus-on-a-public-road 2. https://www.deingenieur.nl/artikel/proef-met-zelfrijdende-bus-tussen-haarlem-en-schiphol 3. https://media.daimler.com/marsMediaSite/en/instance/ko.xhtml?oid=12776336	Non-electric vehicle
111.	The Netherlands	WEpod	Wageningen	2014 – 2016	EasyMile EZ10; Many hard- and software added to vehicle	Max 6 passengers (6 seated and 0 standing)	Max 15 km/h	Phase 1: Around the campus of Wageningen Univeristy Phase 2: From trainstation Ede/Wageningen to Wageningen University	Phase 1: 2500 m Phase 2: 11000 m	Parking ban, 1 traffic light added, wifi-p added to existing traffic light, speed limitation, special bus stop	TU Delft, Christian University of Applied Sciences, ROC A12, HAN University of Applied Sciences, STAD project	1. https://www.researchgate.net/publication/329781953_Casestudy_WEpod_een_onderzoek_naar_de_inzet_van_automatisch_vervoer_in_EdeWageningen 2. https://journals.sagepub.com/doi/10.3141/2542-09 3. https://ieeexplore.ieee.org/document/7986800 4. https://www.raddelft.nl/wp-content/uploads/2017/06/Paola-Rodriguez-Safety-of-Pedestrians-and-Cyclists-when-Interacting-with....pdf 5. http://stad.tudelft.nl/wordpress/wp-content/uploads/2017/01/CIT2016_JPNunezVelasco_Stockholm.pdf 6. https://viridearchitecture.jimdo.com/	Most infrastructural changes were needed for phase 2.
112.	United Kingdom	Citymobil	Heathrow PRT	1. October 2010 – May 2011 2. May 2011 – end date not mentioned	"ULTra" - developed by Advanced Transport Systems of Thornbury	Max 4 passengers	Max 40 km/h	From carpark to terminal 5	3900 m	Elevated, dedicated lane	Part of Citymobil project	http://www.citymobil-project.eu/site/en/Heathrow%20PRT.php	1. Trials 2. Full passenger service
113.	United Kingdom	Citymobil	Daventry	24th of September – 5th of October 2007	INRIA vehicle	Not mentioned	Not mentioned	Not mentioned	400 m	Operating on bicycle track (4 m wide)	Part of Citymobil project	http://www.citymobil-project.eu/downloadables/Deliverables/D1.5.1.3-PU-Daventry%20Showcase%20report-CityMobil.pdf	
114.	United Kingdom	Project Synergy	Manchester Airport	November 2017 – May 2020	Westfield electric AV pod	Max 4 passengers (4 seated and 0 standing)	Not mentioned	From Airport station to terminal 2.	500 m	Not mentioned	UK Autodrive	https://space.uitp.org/initiatives/project-synergy-manchester-av-uk	
115.	United Kingdom	UK Autodrive project	Milton Keynes	2015 - 2018	Pod built by RDM-Group Aurrigo	Max 4 passengers (4 seated and 0 standing)	Not mentioned	From railway station to city centre	Not mentioned	None, operates on pavements and other pedestrianised areas.	Not mentioned	http://www.ukautodrive.com/pods-provide-a-first-last-mile-solution-in-milton-keynes/	
116.	United Kingdom	Stagecoach/ ADL/ Fusion Processing	Edinburgh	Planned for 2020	Enviro200 by ADL	Max 42 passengers	Not mentioned	From Ferrytoll Park to Ride facility in Fife and the Edinburgh Park train/tram interchange	22000 m	Dedicated lanes	Stagecoach, Transport Scotland, bus manufacturer Alexander Dennis, Fusion Processing Ltd, ESP Group	1. https://www.alexander-dennis.com/media/news/2018/november/scotland-to-trial-first-autonomous-full-sized-bus-fleet-in-passenger-service-after-435m-innovate-uk-funding/ 2. https://www.sustainable-bus.com/news/autonomous-bus-fleet-pilot-in-scotland-from-2020-by-stagecoach-and-adl/ 3. https://www.bbc.com/news/uk-scotland-edinburgh-east-fife-46309121	

	Country	Project	Location	Date	Vehicle	Capacity	Speed	Route	Length	Infrastructure	Research	More information	Comments
117.	United Kingdom	GATEway	London	February – March 2018	Fully automated passenger shuttles (provided by a consortium of Westfield Sportscars, Heathrow Enterprises and Fusion)	Max 4 passengers	Max 15 km/h	Along the riverside path in Greenwich, London	1600 m	In a designated lane, sharing space with pedestrians and cyclists	GATEway project team	1. https://gateway-project.org.uk/ 2. https://gateway-project.org.uk/wp-content/uploads/2018/06/D3.7_TRL-Workshop-Findings-Report.pdf	Max passenger capacity includes the steward
118.	United Kingdom	Stagecoach/ ADL/ Fusion Processing (trial)	Manchester	March 2019	Single-decker bus by Alexander Dennis Limited (ADL) and Fusion Processing	Max 43 passengers (43 seated and 0 standing)	Not mentioned	Within the grounds of a Sharston bus depot in Manchester, England	Not mentioned	Not mentioned	The purpose of the trial is to test if the bus can undertake manoeuvres such as parking and moving into a washing area	1. https://www.cnbc.com/2019/03/20/uks-first-self-driving-bus-begins-trials.html 2. https://travelandynews.com/uk-stagecoach-self-driving-bus-trials/	