VIENNA'S POSITION PAPER ON AUTOMATED MOBILITY

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Contents

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Vienna, one of the most livable cities in the world

Experts agree that a high fleet penetration of fully automated vehicles[1] (AV) is a very likely long-term future scenario.

For the city of Vienna, the question arises**: how can automated driving contribute to ensuring that Vienna remains one of the most livable cities[2] in the world?**

While technological development is being driven by the automotive and IT industry, it is the task of the public sector to pay attention to its effects and side effects, to analyze them and to set framework conditions in such a way that a mobility system is created that is functional for everyone and committed to the common good.

The following guiding principles should provide orientation during this transformation phase:

- Overarching transport policy objectives, particularly as defined in:
    - the Smart Climate City Strategy,
    - the Vienna Climate Roadmap,
    - the Urban Development Plan, and
    - the Mobility Master Plan,

  remain in place.

- We measure automation in transportation by its added value to society (climate footprint, traffic safety, environmental effects, attractive public spaces, mobility options for people who so far have not been able to be mobile independently...)
- Automated mobility should contribute to guaranteeing mobility (in the sense of the Smart Climate City strategy). Transport is not merely a technical system, but also has a social function that enables participation and prosperity.

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1 At Level 5 acc. SAE definition, i.e. the driving task is performed entirely by the vehicle; this document only considers road traffic.

2 https://www.wien.gv.at/politik/international/vergleich/mercerstudie.html; https://www.wien.gv.at/politik/international/vergleich/lebensqualitaet-ranking-economist.html

Current situation[3]

It is currently assumed that there will be a very long transition phase from non-automated to fully automated driving. During this time, the fleet penetration levels of the SAE levels will appear in different constellations. Level 4[4] (full automation in defined operational design domains) is just reaching the market. It is likely to be significant for a very long period, whereas there are still no concrete timelines for the availability of Level 5[4] (full automation). Particularly due to motorcycles and other single-track vehicles, vintage cars, vehicles from third countries, etc., a complete L5 scenario is unrealistic in the short and medium term.

This is particularly relevant for strategies of cities and their administrations, as L4 vehicles, which are limited to a few operational design domains (ODDs[5]) have completely different effects than L5[4]-vehicles. In summary:

L4 with few ODDs makes driving more attractive without fundamentally changing the rules. A traditional driver is still needed for the remaining, non-automated ODDs. Unregulated, the mileage would increase, while the need for parking would remain similar to the current situation. Traffic safety per vehicle kilometer travelled[4] would improve.

L5, on the other hand, could mark a turning point in mobility and lead to profound changes. There would no longer be a traditional driver, parking at the end of the trip would no longer be necessary and automated Demand Responsive Transport (DRT)[4] would be possible. As empty trips would become possible, travel time would not be tied to the driving task, and an extended user group would be addressed (no driving license required, alcohol, medication, or fatigue less problematic), the mileage would increase ceteris paribus.

Since L5 favors both car sharing and ride sharing, fleet size decreases while the mileage remains constant. For this reason, many studies predict significantly less overall parking demand. In any case, parking demand decreases in zones where parking is unattractive because parking is no longer necessary at the destination.

Traffic safety per vehicle kilometer travelled would improve. Since L5 vehicles behave strictly compliant and defensive in mixed traffic with non-automated road users without accompanying measures, the throughput on the roads may suffer.

Social acceptance is likely to increase further over time due to the co-evolution of technology and society without any special measures, as people increasingly come into contact with automation technologies in many areas of their lives.

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[3] In accordance with, among others:

- „Räumlich-differenzierte Auswirkungen des automatisierten Fahrens", Planungsdachverband Region Zürich, TU Wien, Austria Tech im Auftrag des Bundesamts für Strassen, Schweiz, 2023
- Modellierung der Wirkungen des automatisierten Fahrens in der Stadt, Metastudie, Deutsches Zentrum für Luft- und Raumfahrt im Auftrag der MA 18, 2018

[4] See appendix for definition

Vienna's responses to automated driving

A livable city, excellent environmental quality, and attractive public spaces while guaranteeing mobility are possible. Autonomous vehicles (AV) can make a significant contribution to this. To achieve this, however, the right course must be set. These conceptual issues and regulatory requirements are presented below.

SPACE & EFFICIENCY

- 15-minute city: Compact, dense cities offer a multitude of possibilities within short distances. This means chances and opportunities for residents and excellent framework conditions for modes of the eco-mobility.
- **Space-efficient modes of transportation are important.**
    - High-performance public transport (PT) axes are indispensable due to their energy efficiency[5]. Their space efficiency is just as important. What applies to urban development also applies to the transport system. It must make highly efficient use of scarce space (especially at peak times).
- **Demand Responsive Transport (DRT[6])** provides attractive and efficient options for low-demand scenarios. The city of Vienna actively addresses this topic through pilot projects. The following guidelines apply:
    - DRT always includes a sharing component, ideally in the form of ride-pooling.
    - DRT operates when the use of conventional PT becomes inefficient (e.g. off-peak-times, less dense, peripheral areas).
    - DRT can operate across city boundaries. There they bridge the so-called "first or last mile" (between high-performance PT axes and nearby addresses). Additionally, they extend the PT services in unserved or underserved areas.
    - DRT typically does not operate in dense, central areas during the day. Here, maintaining the bundling potential of the existing, excellent PT service has priority.
    - DRT primarily acts as feeder to high-performance PT axes. They only operate as direct connections if there is no impairment of the bundling potential of the existing, excellent PT service.
    - DRT is deeply integrated into the existing PT system (information, routing, booking, payment).
    - With driverless systems, the safety needs of passengers will require special consideration.
- **The city of Vienna provides incentives for high occupancy rates:**
  The number of people per vehicle is a crucial factor in avoiding traffic jams, energy consumption, emissions, etc. At an occupancy rate of 0.5, four times more resources are consumed than at an occupancy rate of 2, with the same number of passenger kilometers travelled. Ridesharing solutions[7] are particularly important here. They are both economically and ecologically sensible.[8]
- **The city of Vienna's goal is for AV to use only decarbonized powertrains.**
- **Cooperation within the region:**
  We aim for compact settlement structures throughout the entire Vienna city region. A region of short distances is ecologically and socially beneficial.
- The **efficiency of existing PT systems is also increased through automation.** This can include forming clusters of a maximum of 2 vehicles (buses or DRT) with a maximum individual vehicle length

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5 See European Green Deal, Smart Climate City Strategy

6 Demand Responsive Transport; see also appendix

7 Platform operators provide users with server-supported automated carpooling opportunities.

8 Important influencing factors are occupancy rate (can fall below 1 due to empty trips) per trip or per mileage per vehicle; propulsion; modal shift within the eco-mobility or from MIT to eco-mobility? induced new traffic?

of 13 m each through platooning[4]. Where the feasibility is demonstrated through detailed analysis, pilot projects should be conducted.

SAFETY

- AV must be intrinsically safe. They must also be able to deal with partial system failures or poor weather conditions ("fail-safe").
- AV must not rely on public infrastructure to drive safely. This is their own responsibility, including liability. Autonomous vehicles must adapt to public spaces, not the other way around.
- AV may only be approved if they demonstrably drive significantly safer than humans. This must be specifically defined and legally ensured by the federal government/EU.
- IT security must be ensured by design. Remote control options pose a particularly high potential risk.
- AV must be able to cope with all types of road users, especially:
    - Non-autonomous/non-connected vehicles in mixed traffic
    - Public transport (mixed traffic)
    - Vulnerable road users such as pedestrians and cyclists. No new obligations shall arise for them (e.g. carrying devices that facilitate their detection).
- Just like technical factors, human-organizational factors[9] must also be taken into account:
    - AV must be predictable and safe for their users and other road users. High attention must be paid to the human-machine interface. In particular, other road users or emergency services must be able to recognize the state and intention of the AV.
    - The capabilities and limitations of an AV must be transparent so that people can trust them appropriately but avoid over-reliance.
    - The high degree of compliance of AV is a quality, as it leads to higher traffic safety and better mixability of sojourning options in road-space. Misuse of this defensive, safety-optimized behaviour by specific human behavioural adaptions (very risky behaviour, deliberate obstruction) must be countered.

INFRASTRUCTURE

Public space is for people.

Ongoing efforts and regular checks ensure a high level of quality in public spaces. Nevertheless, public space is inherently imperfect. AV must not assume that perfect laboratory conditions will be found in the real world.

- AV can deal with existing traffic guidance systems and traffic signs.
- AV adapt to the city, not the other way around. There shall be no need for new infrastructure in public spaces to compensate for any shortcomings of automated individual transport (not even during the introductory phase). This should be achieved through technological advancement of the AV itself[10]. There are three exceptions to this basic approach:
    - The pilot testing[11] of automated public transportation

[9] See EU Agency for Railways: https://www.era.europa.eu/domains/safety-management/human-and-organisational-factors-hof_en
[10] There are federally funded testbeds such as DigiTrans or ALP.Lab for this purpose.
[11] In any case, clearly limited in terms of time, space and quantity

- Public C-ITS equipment[12,13] at particularly suitable locations is sensible. This mainly concerns traffic light locations because they are crucial for traffic management, power and data lines are available and suitable maintenance structures exist. Here the goal is:
    - to provide an additional safety layer for even higher traffic safety. However, public C-ITS equipment must never justify a lack of inherent safety of the AV itself.
    - to optimize traffic flow (at selected critical points in order to buffer performance drops that are deemed unacceptable).
- The city of Vienna is aware that AV decisions must be based only on reliable and sufficiently up to date data. These high quality requirements are taken into account when the city of Vienna provides electronic data in this context. In this way, the city of Vienna only provides data if this is socially beneficial[14].
- International standardization must not be at the expense of road maintainers
    - No extension of the liability of road operators
    - No gold-plating for road infrastructure
- Barrier effects of transport infrastructure in urban areas must not increase.
- Transport infrastructure works for all road users.
- AV drive (connecting function) in a rule-compliant, defensive, and low-emission manner. This opens up new opportunities for attractive public spaces for strolling, chatting, and playing (recreational function).
- Parking of the future, once L5 and ridesharing prevail:
    - The demand for long-term parking spaces will decrease. It will be more attractive to use fully autonomous cars when needed rather than owning them. Responsibility and decision-making over operational driving decisions as well as maintenance and service of the AV will lie with the manufacturer/fleet operator. This will severely restrict the freedom of choice of any private owner.
      In this potential Mobility as a Service scenario, vehicles will not be parked 23 hours a day like the cars of today. Instead, cars will provide transportation services. Therefore, while maintaining constant kilometers driven, the fleet size and parking space requirements will decrease.
    - Long-term parking directly at the travel destination in premium locations will become less important because AV will not have to park at the destination.
    - As a result, the most important control instrument to date, parking space management, becomes less effective. In order to achieve the transport policy goals, additional measures will be needed in the following two areas:
        - Mileage reduction through measures that directly address the traffic flow
        - Strong incentives for high occupancy rates (ridesharing)
    - Increased short-term stops (hop on/off, deliveries, etc.)
    - Curbside management and multi-functional zones increase space efficiency through temporally staggered use of the same space. This satisfies demands for curbside space (for short-term stops, hop on/off, deliveries, etc.) and quality of living space (trees, parklets, sidewalk cafes, etc.) in street spaces. Long-term street parking is viewed restrictively (inefficient use, contradicting strategic mobility and environmental goals).
    - The topic of street space and in particular the "curbside of the future" holds significant importance. Usage requirements compete and change dynamically (decreasing demand for permanent parking spaces, space for short-term stops and deliveries, hop on/off, non-

[12] C-ITS Platform, Final Report, https://ec.europa.eu/transport/sites/transport/files/themes/its/doc/c-its-platform-final-report-january-2016.pdf

[13] EU Directive 2010/40 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport, last amended by Directive (EU) 2023/2661 https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32010L0040

[14] If necessary, this could be information about traffic light switching states, traffic circulation plans or prohibitions and restrictions. However, detailed checks are required. There are links to open government data and the digital twin.

motorized traffic, sojourning quality, urban development, electrification, climate change adaptation).
    - The city of Vienna will undertake further in-depth considerations on curbside management.

As the penetration of Level 5 vehicles increases, the importance of road infrastructure elements influencing driver behaviour decreases. Examples include speed bumps[15] or road chicanes as well as traffic signs or information elements that serve to raise awareness (e.g. "Attention, children", "You are driving at 43 km/h"). Critical infrastructure and sensitive urban areas will still need protection through bollards, modal filters, boulders, etc., even with high Level 5 fleet penetration.

Prior to this L5 scenario, a relatively long L4 and mixed-traffic scenario (see “Current situation”) will dominate. L4 makes driving more attractive. To avoid increases in traffic volumes, control measures must be implemented. Fortunately, established control measures will continue to be effective even under L4.

TRAFFIC MANAGEMENT

Navigation and driving decisions are increasingly not made by humans but automated systems.

In the future, traffic management will be even more data-based. In addition to established management techniques such as prohibitions, restrictions and street space design, incentive systems will be added. This expanded repertoire enables more accurate monitoring (fine-tuning instead of broad strokes).

- Data-based management requires data.
    - AV generate extensive data on road and traffic conditions, routes, and travel times. This data must be accessible to public authorities for planning and traffic management purposes. This is not about vehicle specific data, but about aggregated indicators (e.g. slow-moving traffic, safety incidents, car park availability, etc.). Initial steps in this direction can already be seen in the development of (international) legal frameworks.
      Especially if aggregated routing data and bidirectional interfaces with traffic information services and navigation systems are established, effective traffic demand management can be conducted.
    - Traffic management is and remains a public task. In the urban area, it is the responsibility of the city of Vienna, its enterprises, and the police. Democratically legitimized traffic, environmental, and economic policy objectives are pursued.
      The city of Vienna is committed to regulatory measures to ensure that private service providers like Google Maps, Here, or TomTom integrate constructively.
    - The city of Vienna actively engages in integrating new data sources (especially real-time data) into basic traffic control, including the VLSA circuit. This allows for faster and more targeted responses (e.g., optimized public transport control depending on traffic conditions and schedules).

- European perspective: In this context, the discussed Real Time Traffic Information Delegated Regulation[16] provides the following focus:

[15] This does not refer to raised levels, which are crossing aids for active mobility.
[16] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2022:122:TOC

    - Urban traffic circulation plans[17] must be displayed by private navigation services (Article 5, Paragraph 4) when digitally published in the prescribed formats by the city of Vienna. This contributes to directing through traffic only onto main roads. Residential areas and sensitive zones should be kept free of through traffic, even in the era of connected navigation systems.
    - Access to in-vehicle-generated data for traffic management purposes under favorable conditions (Article 6, Paragraph 5, see Annex: FRAND Conditions; possibly also in conjunction with the Data Act, EU 2023/2854[18], Art 14 ff.)
- Ensure coordination of municipal administrative action with European legal frameworks.

- Routing should prioritize system optimization over individual optimization:
    - Route selection (no shortcuts through residential areas/school locations)
    - Consider cumulative effects in order to optimize overall throughput.
    - The city of Vienna is committed to multimodal routing options.
    - Take full advantage of existing high-capacity public transport axes instead of being stuck in traffic jams parallel to subway lines (multimodal routing).
    - Identify and minimize overload conditions. Ideally, connected navigation systems of AVs transmit their routing via an interface to the traffic control center of the road infrastructure operator. Aggregating these routing data in real-time can anticipate impending overload conditions (anticipatory traffic management), with a strong emphasis on privacy-compliant solutions.
- **Mileage per vehicle must not increase due to automation.**
- Organizational and technical optimizations of the traffic management center are to be examined against the background of increasingly extensive tasks.
- Traffic management prioritizes public transport (except when ahead of schedule), pedestrians, and cyclists even when using modern technologies such as C-ITS.

COMMERCIAL TRANSPORT

Commercial transport plays a crucial role in the supply of goods and services. Nevertheless, this mode of transport must also be evaluated based on its overall societal value, including its environmental impacts.

Regarding automation, it is foreseeable that beyond current assistance functions (such as right-turn assist, emergency brake assist), L4 functionalities such as finding a parking space, parking or moving the vehicle at low speed and truck platooning on highways (will) gain increasing significance[19]. The effects of these developments on cities and traffic systems seem manageable.

The city of Vienna positions itself as follows regarding automation aspects:

- Platooning is not an urban-friendly form of transportation. This is primarily due to its fragmentation effect and unresolved issues regarding traffic safety in mixed traffic.
    - Within urban areas, platooning is only conceivable in public transport bus lines and DRT public transport services, coupling 1+1 vehicles with a maximum individual vehicle length of 13 meters.

[17] Refers to permanent traffic management measures that are developed with the aim of controlling and directing the flow of traffic in response to permanent or recurring traffic disruptions
[18] https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=OJ:L_202302854&qid=1720074629659
[19] See Autonomes Fahren im Liefer- und Güterverkehr, Strategiedialog Automobilwirtschaft Baden-Württemberg, https://vm.baden-wuerttemberg.de/fileadmin/redaktion/m-mvi/intern/Dateien/PDF/PM_Anhang/210505__ANHANG_Empfehlungspapier_AG_B_autonomes_Fahren_im_LGV.pdf

    - On highways, platooning of buses and trucks is conceivable, although the tight distances between junctions and interchanges in Vienna must also be taken into account.
- Parcel delivery/Delivery robots
    - Sidewalks are used for non-motorized mobility.
    - Automated deliveries may only use roadways and parking lanes (see "Curbside management"), but not sidewalks. This is due to the high usage on urban sidewalks. Additionally, small deliveries by delivery robots, especially over longer distances, appear problematic due to high traffic volume and many empty runs.
    - Sidewalks or footpaths may only be used for the shortest possible, very last segment between the nearest street and destination (address, parcel box).
    - With automated delivery, significant attention must be paid to the interface with the end customer (How does the end customer receive his parcel?). Delivery robots are not allowed to park or wait in public spaces.
    - If CEP services aim to deliver automatically in the future, this interface issue with the end customer is crucial from the city's perspective in order to prevent overuse of public space. This will likely only be feasible through automatically deliverable reception boxes (B2B, B2C), neighbourhood hubs capable of automated delivery, so-called parcel shop partners (especially B2C), and automated delivery areas (B2B).
    - Thanks to its interoperability and openness to all delivery service providers, the ViennaBox parcel box system already contributes significantly to space efficiency and traffic reduction. Further development towards automated delivery should be monitored in line with market developments. Provision for necessary spaces should be made through urban planning and the development of the legal framework, with the use of public space only in exceptional cases.
    - Automated delivery in the above mentioned goods transfer areas (B2B) can create potential for shifting deliveries to times with less traffic. However, noise disturbance should be avoided during night deliveries in residential areas.

ADAPTION OF THE LEGAL FRAMEWORK

In many areas, (primary) responsibility lies with the EU or the federal government. The city must monitor and participate in this legislative process.

The spectrum ranges from licensing regulations, type approval, safety requirements and rules on intelligent transport systems to regulatory cross-sections and the reflective properties of road markings.

From an urban perspective, it will be crucial that:

- Cities are effectively empowered to steer based on data by providing:
    - Access to fleet data
    - The ability to collect own data (including video-based counting data)
    - The legal basis for data processing
- Cities are not burdened with unreasonable obligations (gold plating of physical or digital infrastructure, adaption of liability).
- All regulations, including those issued by cities themselves, work appropriately in various scenarios leading up to L5 (parking regulations lose their control effect; do the rules work even if followed to the letter?).
- Rules are designed in a way that they can be (easily) mapped digitally[20].

[20] See also "Measure 4: Digital check for legal matters" in: Action plan on digital transformation in mobility, BMK, 2022, source: https://www.bmk.gv.at/dam/jcr:7e7be1ef-3536-49d8-b619-3ca7e81e30c5/BMK_APDTM.pdf

COORDINATION AND KNOWLEDGE EXCHANGE

Developments in the field of automated mobility are dynamic, both from a technical and legal perspective, and have a strong international component. This is also highlighted by the federal government's involvement at EU level, the United Nations Economic Commission for Europe (UNECE), the Connected Cooperative and Automated Mobility (CCAM) Partnership, the States Representative Group (SRG), and the High Level Meeting on Automated & Connected Mobility (HLM)[21].

Intensive monitoring and occasional participation by the city of Vienna are advisable. Currently, this responsibility is decentralized among respective specialized departments. This involvement should be intensified on the one hand, and internal coordination and knowledge management should be strengthened on the other. Existing internal structures (MA 18, MA 33, MA 46, Wiener Linien, Wien Haus) and external structures (FSV, Eurocities, Polis, UITP, etc.) should be used for this purpose.

The Working Group on Automated Mobility (MD-BD/KPP, MA 18, MA 33, MA 46, Wiener Linien) is to be continued in approx. 4-monthly working group meetings in order to contribute to coordination and knowledge exchange.

CONCLUSION

Automated vehicles with decarbonized powertrains, utilized as shared Mobility as a Service (high occupancy), complementary (not competitive) to existing high-performance public transport, and without increasing mileage per vehicle, can contribute to enhanced quality of life and positive environmental impacts. The focus is on offers and services rather than on restriction and sacrifice.

[21] See position paper on automated mobility, BMK, december 2023, p 13

List of abbreviations/Glossary

Extract from SAE Levels acc. to SAE J3016, rev. 2021

Level 4: High Driving Automation:

The sustained and ODD-specific performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will need to intervene. The ODD is limited.

Level 5: Full Driving Automation:

The sustained and unconditional (i.e., not ODD-specific) performance by an ADS of the entire DDT and DDT fallback without any expectation that a user will need to intervene.

ADS: Automated Driving System

AV: (Fully) autonomous vehicles

Carsharing: Unlike ridesharing, the same vehicle is not simultaneously shared but staggered.

C-ITS: Cooperative Intelligent Transport Systems

Curbside Management: There are various definitions. Here, we understand the curbside as the area between the road and the curb or another boundary marking. The road is not part of the curbside. Curbside management involves a flexible organizational scheme for the curbside. It includes all activities that deal with the recording, optimization, and management of the curbside.

DDT: Dynamic Driving Task

DRT: Demand Responsive Transport

FRAND: Fair, Reasonable and Non Discriminatory

in-vehicle-generated data: Data generated by vehicles

MaaS: Mobility as a Service

Mileage per vehicle: Measure for the mileage of fleets

ODD: Operational Design Domain; operational scenario of a vehicle (e.g. highway)

Platooning: A lead vehicle takes over the DDT. Subsequent vehicles are electronically connected and follow the lead vehicle automatically (electronic drawbar).

PT: Public Transport

Ridesharing: Individuals share a vehicle for a common segment of their trip. Pooling is managed through a digital platform.

Traffic Circulation Plan: There are various definitions. Here, it refers to a traffic graph indicating preferred routes to use in cases of congestion or diversion.

White-Label-Boxes: Boxes equipped with an electronic locking system where various delivery service providers can deposit packages. Recipients then collect their parcels from these boxes.