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Urban Vehicle Access Regulation for European Cities: Implications for Traffic Management 2.0 deployment

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Abstract

Across Europe increased urbanization is providing challenges for cities due to negative side-effects of increased urban mobility and public space demand. Attempting to find a balance between Open accessibility and restricted access in vehicle access regulation, several European municipalities have developed Urban Vehicle Access Regulation schemes (UVARs). These aim at monitoring and managing mobility in and around city centers. However, the heterogeneity in UVAR implementations resulting from the variety in policy frameworks and technical deployment typologies and capabilities, has created unfair barriers for accessibility of cities and come at higher implementation costs. They also exhibit unintentional discrimination due to limited data-sharing and lack of available information for users and mobility stakeholders alike. The ERTICO TM2.0 Innovation Platform Taskforce on Intelligent Access has performed an inquiry into UVAR motivations and typologies, and has assessed the potential for eliminating these barriers by (1) investigating how current UVAR schemes relate to common TM2.0 typologies and capabilities, and (2) how new UVAR concepts (UVAR 2.0) would benefit from a multi-stakeholder public private win-win cooperation as constructed and proven as TM2.0 in traffic management context.

Keywords: Urban Vehicle Access Regulation, UVAR, Traffic Management 2.0, TM2.0, Interactive Traffic Management, Standardisation

Introduction

If any location has the character of continuous change, evolution and adaptability, of ‘continuous temporality’, it would be a city. What most cities have in common for the past and coming decades however, is growth. Across Europe increased urbanization is providing challenges for cities and urban areas regarding negative side-effects of increased urban mobility, and increased demand for public space. This is also the case for urban road infrastructure, parking facilities, and loading bays, where a strong increase of private and commercial mobility in city centers is leading to traffic congestion, and its well-known implications on traffic safety and air quality. Especially for cities and urban regions with a more historic infrastructure, the possibilities to adapt to this increased and dynamic demands mentioned above are limited. That means that for these cities the negative side-effects are more

problematic. In general however, managing and/or restricting mobility is inherently challenging for cities, as the attractiveness and economical functions of a city are strongly dependent on the city being open and accessible to vehicles carrying people and goods.

In attempts to find a balance between open vehicle access and restricted vehicle access in traffic management regulation, European municipalities have developed multiple different schemes for monitoring and managing mobility in and around cities. These schemes usually stem from a variety of political and societal drivers, and their implementation can vary in terms of complexity and typology of the technology used. These different schemes are known as Urban Vehicle Access Regulation schemes (UVARs), and can be broadly defined as: 'measures to regulate vehicular access to urban infrastructure' (EC, 2017).

In many ways, deploying a UVAR scheme within a city is not that different from deploying any other traffic management and Intelligent Transport Systems (ITS) scheme for an urban area. However, in comparison to most traffic management schemes in recent years, an UVAR scheme bears additional KPI's such as those referring to air quality, public space occupancy monitoring, as well as specific policy targets per mobility target group (e.g. restricting heavy logistics/diesel cars, facilitating bicyclists/public transport). In the past few years, increased connectivity, improved sensor capabilities, use of in-car information services and improvements in traffic management ICT infrastructure have enabled both the measuring and the acting upon these new KPI's. This shift has transformed the traffic management/ITS practice from deploying 'collective' measures (TM 1.0) to performing a more individualized, more functional and tailor-made traffic management (TM 2.0) (EC, 2019[a]). The public and private members of the ERTICO TM2.0 innovation platform believe in collaboration among European public and private mobility stakeholders in order to work towards (1) achieving better insights in the infrastructure status for road authorities, (2) developing more effective tools to influence this status where needed, and (3) offering improved services by service providers to their mobility users (TM2.0, 2019). These individualized traffic management services and tools will enable the monitoring of these new KPI's, as well as the management of regulation in a dynamic, individualized and balanced manner.

The Taskforce on Intelligent Access Regulation of the TM2.0 Innovation Platform believes that the lessons learned in the development and deployment of TM2.0 could contribute to the development of dynamic and individualized 'UVAR2.0' schemes, aimed at higher policy impact and seamless mobility. In order to support these efforts, the taskforce has (1) made an inventory of different European UVAR implementations policy schemes and setups, (2) assessed the relations between TM2.0 and 'UVAR2.0' schemes and (3) identified the implications of these UVAR schemes for TM2.0 deployment. The work of the taskforce started in November 2019, and results are presented at the Virtual ITS European Congress in November 2020.

European Urban Vehicle Access Regulation Schemes

UVAR Schemes are not new. The ancient city of Rome has been known to have had zones where

wheeled traffic (e.g. horse carts and carriages) was restricted between sunrise and 'the 10th hour of the day' for the purpose of reducing congestion and increasing pedestrian safety (Laurence, 2008). Modern cities, under the pressure of increased urbanization and more strict environmental policies, have paid increasing attention and effort for UVAR deployment. Within Europe, various forms of UVARs are (to be) deployed, resulting from different policy frameworks and implemented in different typologies. The 2017 UVAR study by the European Commission identifies three different main motivations for UVAR deployment, either in isolation or in combination:

1. *Environmental aims*
   Examples are various Low Emission Zones, where vehicle access is regulated by cities to tackle issues related to EU air quality limit values for particulate matter and NOx.
2. *Reducing Congestion*
   Examples are Milan, London or Stockholm where the key target is to reduce congestion, improve air quality and urban accessibility, and/or to foster development of alternative transport modes and the use of cleaner vehicles.
3. *Raising Revenues*
   Example is the Norwegian urban road tolling system, where funding road construction from toll revenue has been practiced for over 70 years.

Although the above-mentioned motivations are the most frequent for UVAR explorations and implementations, additional (less frequent) motivations are also used by cities in Europe. These include improving traffic safety (Antwerp), preserving historic urban infrastructure (Siena, Amsterdam), mitigation noise pollution (Gothenburg), and even improving public safety in the light of terrorist attacks using trucks (Stockholm).

Partly based on this variety of motivations for exploring and/or deploying UVARs, the typology of these UVARs varies as well. The 2017 EC UVAR study identifies five:

1. *Cordon-based*
   Vehicles are not allowed to cross a cordon which may vary by time of day, direction of travel, vehicle type and location.
2. *Area license-based pricing*
   Charging a fee for driving within an area during specific hours. Fee and/or rules might vary by time of day and vehicle type.
3. *Toll rings (Highway tolling)*
   Similar to cordon-based, but generally applied to regulate access to the entire city.
4. *Point-based*
   Vehicles are not allowed to cross through specific points in the city (e.g. bridges, tunnels, or specific sections)
5. *Distance or time-based*

Pricing scheme based on distance or time a vehicle travels along a congested route or specified area. It may vary with time, vehicle type and location.

European UVAR Challenges

As seen above, UVAR motivations and typologies come in a wide range of ways to implement, and this heterogeneity creates barriers for the cities' accessibility. They may also result in higher implementation costs as well as in unintentional and undesired discrimination due to limited data-sharing among mobility stakeholders and lack of information provided to users (DG Move, 2018). This heterogeneity could potentially continue to grow unless cities and mobility stakeholders do not take necessary action to mitigate this effect.

Making UVARs more dynamic and using geofencing and integrating Fleet management systems and navigation service providers in UVARs may have a counter effect if not planned carefully (EC, 2018). In line with DG Move and the Civitas ReVEAL project (Polis, 2019), the TM 2.0 taskforce on Urban Intelligent Access foresees potential in reducing costs, improving UVAR effectiveness and harmonizing UVAR schemes by:

- as much as possible making use of the existing technological infrastructure
- using existing TM data standards and European data sharing typologies as starting point for UVAR data sharing standards
- taking into consideration the evolving and upcoming relevant technologies ('UVAR 2.0': Geofencing, V2I & V2V communication, etc.) when planning in Traffic Management.

European UVAR Standardization potential

Despite the different known typologies of UVAR schemes in Europe, functional characteristics of the technology behind UVAR schemes are comparable, providing various opportunities for standardization. All known systems require different forms of *sensing*, which might vary from identifying license plates through ANPR to measuring air quality levels. Data from these sensors is *communicated* (in wired or wireless manner, and in standardized, open or proprietary data format) to one or more *data platform(s)* (either local or centralized) for locally storing and distributing this data. On these data platform(s), different *applications* are running in which functions such as data-fusion, vehicle identification and authentication, geofencing management are performed for the purposes of billing in case of road-tolling schemes, and of deciding on how to use (and communicate to) the *actuators* of the UVAR scheme (such as Variable Message Signs (VMSs), traffic lights and enforcement services). These actuator systems/data platform(s) exist in different shapes, ranging from local to centralized, and from more monolithical to horizontal, but they all have clear common denominators. Especially the character of the sensors, actuators and applications, depend on the motivation and typology of the UVAR. Environmental aims require more environmentally related sensing and prediction, relating vehicles to their emissions category, restriction actuators and enforcement measures (e.g. fining). Congestion aims require more sensing in congestion, occupancy

traffic volumes and travel-times, reasoning more on network-wide traffic management and prediction, and actuators on rerouting and restricting vehicles. Tolling and revenue based schemes require more license plate recognition, authentication, movement monitoring, tariff calculations and billing. Regarding typologies, cordon-based typologies (especially with dynamic aspects) will require GIS based data (e.g. geofencing), distance/time based typologies will require individual vehicle tracking (either through using on-board hardware or through distributed identification sensors throughout the UVAR zone), and area license based pricing typologies will require communication on tariffs and timeslots. In order to further continue the standardization efforts in UVAR domain, the EC has launched a prepatory action on building an open-source UVAR data platform, where European UVAR data can be shared and retrieved through a platform with related UVAR standardized profile (Polis, 2019). With multiple TM2.0 platform partners involved the specific lessons on the technical nature of standardizing these schemes will be shared between the TM and UVAR domains.

UVAR2.0

Looking forward in the UVAR domain, the 2019 UVAR and SUMPs topic guide by Polis introduced the notion of 'UVAR 2.0' looking towards the current set of UVAR schemes (primarily focusing on generic vehicle-type based access restriction) towards the more dynamic and individualized form of 'UVAR2.0'. Prerequisites for UVAR2.0 concepts are that the challenges for scalable UVAR 1.0 implementations are solved, as UVAR2.0 will provide more dynamical, nuanced and targeted policies. Polis foresees that current UVAR schemes might have less impact in the near future as environmental performance of vehicles will improve, and as increased connectivity an services will develop towards 'embedded or forgettable' UVAR zones, where users automatically get rerouted or switched to cleaner fuel mode without having to intervene. The taskforce underlines this difference by introducing the terms 'hard' and 'soft' UVARs, where 'hard' UVARs are limited to generic approaches on limiting access of zones, and 'soft' UVARs emphasize tailor-made policies for, for example, local citizens, tourists, commercial traffic, temporary events, etc., and next to using fines moving towards incentive-based schemes to achieve longer term behavioral change. Examples of such 'soft' incentive based services are now entering the market, with examples such as the Portugese AYR service by Ceiia. By tweaking such UVAR 2.0 schemes to challenges in local context (which often are not kyet known in detail) would allow to build fit-for-purpose policies for local problems, and exchanging this information to a range of target groups that either have to abide by the policy or are merely should be informed. This UVAR 2.0 would, in line with the TM2.0 vision, be constructed by public-private partnerships, sharing of data and an ecosystem of digital policies and related end-user services. These connectivity and services capabilities will allow for 'softer' UVAR schemes, focused on longer term behavioral change using incentives, and going further then a hard decision who can and cannot enter a zone. For 'hard' UVAR schemes, the challenges remain in the field of standardization and effective polity, but as for 'soft' UVARs, the additional research into behavior effects, incentive based scheme impacts and seamless data sharing between involved actors are additional focus points.

Implications for TM2.0 deployment

In many ways, the implementation of both 'hard' and 'soft' UVAR schemes can be seen as specific use-cases for implementing a range of ITS services and capabilities often used for a range of traffic management schemes. However, with a very specific dynamic coming into play when designing access policy for cities, translating this towards a European-wide implementable set of schemes, and adapting the schemes to the local situation. Regarding the challenges for technically harmonizing UVAR schemes, and standardizing UVAR data communication, the transition from TM1.0 to TM2.0 paradigms will provide direct valuable lessons that will be added to the UVAR domain through (among other initiatives) the design of the EV UVAR data platform. Moreover, local decisions on technical implementations by cities will in many cases relate to the local traffic management regime, and therefore will be developing hand-in-hand. Regarding the 'soft' UVAR schemes, the TM2.0 lessons have brought the belief that this could pave the way towards individualized UVAR regulations, aiming for long term behavioral change by use of positive reinforcement measures such as incentive schemes. There are however only a limited number of 'soft' UVAR implementations, with more expected in the near future. The TM2.0 ecosystem would benefit from further exploring the dynamics and impacts of these schemes, as several aspects of incentive-based schemes are expected to enter the field of traffic management as well. These efforts should focus both on technological, organizational and economical aspects of designing, implementing and operating these schemes, as well as the impacts on policy goals and the acceptance rate by end-users. Moreover several aspects on how to operate an individualized dynamic scheme for a specific policy implementation will arise in the domain on the alignment between TM2.0 and (urban) MaaS schemes.

Conclusions

The study conducted by the TM2.0 taskforce on Intelligent Access Regulation into different UVAR policy frameworks and typologies has shown three main motivations and five main UVAR typologies, according to which the majority of UVAR schemes can be categorized. Moreover, the identification of UVAR system functions within these combinations has shown a clear potential for standardization and/or making use of existing data sharing typologies and standards used in the traffic management domain, being currently performed by the EC. Looking into the next steps of UVAR implementation, the UVAR2.0 concept, and then especially the 'soft' UVAR implementations, the potential policy impact improvement and the expected challenges in design and implementation are comparable to the phases that characterized the TM1.0 – 2.0 transition. This suggests that lessons learned can contribute to speeding up and increasing the policy impact reached. Moreover, these explorations could be beneficial to inquiries into other domains of TM2.0, such as its relations with Urban MaaS schemes.

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