Preparatory action — User-friendly information tool on urban and regional vehicle access regulation schemes 2
UVAR Exchange

Task 2.1 and 2.2
Challenges and opportunities related to cross-border data sharing for enforcing UVARs

Final Report

PREPARED BY: CORTE, MAPtm, Panteia, ARMIS, AustriaTech, TRT, Sadler Consultants and AlbrechtConsult

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FOR THE
EUROPEAN COMMISSION
European Commission, B-1049 Brussels
Directorate-General for Transport and Mobility
Directorate B - Investment, Innovative & Sustainable Transport
Unit B3 - Innovation & Research Contact: Isabelle VANDOORNE
E-mail: Isabelle.VANDOORNE@ec.europa.eu

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Abbreviations and acronyms

AbgKlassV	Austrian Emissions Class Labelling Ordinance
ACEA	European Automobile Manufacturers' Association
ANPR	Automatic Number Plate Recognition
CBE	Cross-Border Enforcement
CLARS	Charging, Low Emission Zones, other Access Regulation Schemes
CoC	Certificate of Conformity
CORTE	Confederation of Organisations in Road Transport Enforcement
COVID-19	Coronavirus disease 2019 SARS-CoV-2
DATEX	Electronic language used in Europe for the exchange of traffic information and traffic data
DG MOVE	Directorate General for Transport and Mobility
DSRC	Dedicated Short Range Communications
EETS	European Electronic Toll Service
eIDAS	electronic IDentification, Authentication and trust Services
EREG	The Association of European Vehicle and Driver Registration Authorities
ERRIN	European Regions Research and Innovation Network
EU	European Union
EUCARIS	European car and driving licence information system
GDPR	General Data Protection Regulation
IG-L	Immissionsschutzgesetz – Luft
IMI	Internal Market Information System
IRU	World Transport Organization
ITS	Intelligent Transport Systems
LEZ	Low Emission Zone
LTZ	Limited Traffic Zone
mDL	Mobile Driving License
MMTIS	Multi Modal Travel Information services
NIMIC	National IMI Coordinator
NAP	National Access Point
PHEV	Plug-in Hybrid Electric Vehicle
RDW	The Netherlands Vehicle Authority
RTTI	Real Time Traffic Information services
SDG	Single Digital Gateway
SME	Small and medium-sized enterprises
SRTI	Safety Related Traffic Information
SSTP	Safe and secure parking places for trucks and commercial vehicles
ToR	Terms of Reference
UNECE	United Nations Economic Commission for Europe
UVAR	Urban Vehicle Access Regulation
ZEZ	Zero Emission Zone

Executive Summary

Sharing data between countries for enforcing various rules is a complex exercise. It requires connections between several stakeholders, appropriate legal agreements to provide the basis for exchanging data and systems that can ensure secure transfer of data. For UVAR enforcement, further layers of complexity are added to this process due to a range of different reasons, including, but not limited to:

- Multiplication of stakeholders, as local/city level authorities (responsible for enforcing UVARs) need to be involved and provided access to relevant data for this purpose;
- Diversity in mechanisms used by cities/countries to enforce traffic rules and UVARs. For example, while some use physical checks through traffic police, others use automated checks through vehicle number plate recognition.
- Need to consult data on foreign vehicles prior to the occurrence of a traffic violation i.e., *ex ante*, to check if a vehicle complies with a given regulation or not.

In this context, it is fundamental to look at different *data sharing models* and identify the opportunities and challenges associated to them, to determine how data can be effectively shared to foster compliance with and enforce UVARs.

The present report addresses cross-border data sharing for the enforcement of one of the most common and widely used UVAR in the EU, the Low Emission Zones (LEZs). For enforcing LEZs, at a first level vehicle technical data (such as vehicle type, euro emission standard etc.) has to be consulted, to identify if a vehicle is complying with limits set in the LEZ or not. At a second level (if the vehicle is found to be non-compliant) vehicle owner/holder data has to be consulted to issue applicable fines. Accordingly, the report describes challenges related to consulting this data for UVAR enforcement*,* firstly by outlining the diverse mechanisms used by EU Member States at national level to control for traffic offences and secondly by examining the limited scope of different *legal instruments* that can be relevant for exchanging such data.

The report describes 3 different types of *data sharing models* as well as some of the *technical tools* that can be used to implement these models to facilitate data sharing for UVAR enforcement. The data sharing models are:

- ***Authority centric model*** – where data is shared between the vehicle registration authorities of different countries, without the involvement of driver/owner/holder of the vehicle.
- ***Driver centric model*** – where data is shared with the involvement of driver/owner/holder of the vehicle, using a digital credential similar to COVID-19 certificates.
- ***Vehicle centric model*** – where the vehicle itself is the source of data relevant for the enforcement of UVARs.

The opportunities and challenges related to the use of each model are also discussed.

Based on the analysis done, the report identifies some requirements for an effective EU wide solution to share data relevant for cross-border UVAR enforcement. In the next phase of the project, these requirements will allow a deeper analysis of the *data sharing models* and *technical tools* and help develop practical recommendations.

1. Introduction

This report presents the outcome of work done on tasks 2.1 and 2.2 of the UVAR EXCHANGE project (status of March 2022). The objective of the two tasks is to present the complexity of cross-border data sharing for UVAR enforcement, by looking at some of the technical, legal, administrative challenges to data-sharing.

The report presents the preliminary results based on the work done in the UVAR project till date. These results will be further probed and updated in the next phase of the project (under Task 2.3). Accordingly, for a more detailed analysis and recommendations please consult the Task 2.3 and final report of the project.

In this context, the report examines cross-border enforcement of one of the most common and widely used UVARs in the EU (i.e., Low Emission Zones or LEZs) and focuses on challenges and mechanisms for:

- sharing "vehicle data" necessary for checking if a vehicle complies with the established emission limits in an LEZ, and
- sharing "vehicle owner/holder" for non-compliant vehicles, so that necessary fines can be issued.

Chapter 2 provides an overview of the methodology followed.

Chapter 3 considers current enforcement mechanisms used by different Member States at national and cross-border levels and describes the technical challenges that emerge from a diversity in practices adopted by Member States for data sharing and enforcing UVARs. It also considers the legal/administrative issues and provides an overview of different *legal instruments* along with the challenges in using them for exchanging data relevant for UVAR enforcement.

Chapter 4 describes three *data sharing models* (authority centric, driver centric and vehicle centric) that can foster cross-border exchange of vehicle and vehicle owner/holder data for enforcing UVARs and lists the opportunities/challenges related to each model. Some of the *technical tools* that can help implement these models are also described in this chapter.

Chapter 5 lists the requirements that are important for an EU wide solution for exchanging data relevant for enforcement of UVARs. These requirements will be used in the next phase of the project (Task 2.3 and 2.4) to analyse and assess the effectiveness of data sharing models and the technical tools described in chapter 4, for UVAR enforcement.

2. Methodology

The methodology was based on desk research and stakeholder consultation e.g., interviews, bilateral meetings, workshops and the development of a survey.

Desk Research

These tasks started with an extensive desk research, where the key sources were:

- Reports and outcomes prepared under related projects such as UVARBox, REVEAL, LeMO.
- Publicly available documents related to discussions held in EU expert groups and committees.
- Legal resources (such as EUR-lex and United Nations Treaty Collection) for multilateral treaties and EU laws.
- Documents developed by working groups of European Associations such as EREG, IRU, ACEA, POLIS, CORTE.

Stakeholder Consultation

The type of stakeholders consulted through bilateral meetings and workshops were:

- City/Enforcement authorities
- Ministry level authorities
- Data Exchange solution providers – EUCARIS, IN GROUPE and Vehicle Manufacturers
- Vehicle Registration Authorities through EREG
- European Associations – EREG, IRU, ACEA, POLIS
- European Commission – DG MOVE

Survey

A survey was also designed and conducted in November 2021, inviting primarily city/enforcement authorities to share the challenges they face in exchanging vehicle data and vehicle owner/holder data for the purposes of UVAR enforcement. The survey was disseminated to POLIS, ICLEI, Eurocities and ERRIN network, as well as through social media.

3. UVAR enforcement landscape and general challenges

3.1 UVAR description

The most common typologies of UVAR in Europe are:

- Pedestrian Zone
- Limited Traffic Zone
- Low / Zero Emission Zone
- Congestion Charge Zone
- Pedestrian Priority Zone

For more details on the typologies of UVARs, consult the report from task 1.1 on "Practical aspects of UVAR information provision through signage".

Error! Reference source not found. provides an overview of the number of UVAR in the EU countries based on the CLARS database from urbanaccessregulations.eu.

Table 1: Number of UVARs in EU countries in operation

Type of UVAR	Number (#)
Low Emission Zone	352
Zero Emission zone	5
Emergency scheme	40
Limited Traffic Zone (plus a few other Access Regulations)	433
Congestion Charge	20
Total	**850**

Member States use different enforcement methods. There is manual enforcement, by the police or other authorities that covers the majority of the UVARs in Europe. Camera enforcement with number plate recognition (ANPR) is done for 95 of the LEZ/ZEZ ,mainly in Belgium, The Netherlands, Spain, Denmark and Norway. For the remaining UVARS, no figures are available. Manual enforcement is usually aided by a sticker that has to be placed inside the vehicle (Spain, Austria, Germany, Switzerland and France), and by checking vehicle papers in Italy. In Barcelona (Spain) it used a combination of manual and camera enforcement. The CRIT'Air sticker from France is valid in Geneva however, this does not work the other way around. There is a sticker system in the Czech Republic that is aligned with the German stickers, but as yet no LEZs exist in the Czech Republic.

3.2 UVAR enforcement

This chapter presents an overview of the different UVARs in place in several countries and cities, as well as the enforcement schemes in place.

In ***Sweden,*** Stockholm and Göteborg have a congestion tax in place (trängselskatt) for reducing environmental impact and traffic congestion. This also applies to foreign vehicles. The Swedish Transport Agency (see website) has entrusted a notification party to identify the vehicle owners, send invoices and payments via EPASS24. The specific LEZ zones are enforced by manual checks of licence plates that provide registration data of the vehicle. This information includes the vehicles engine type,

as well as any registered technology that is retrofitted in order to lower the vehicles emissions (Amundsen & Sundvor, 2018).

In ***Denmark,*** LEZs are in place for diesel vehicles, see miljoezoner.dk. The rules will be tightened over the coming years for light duty vehicles. Enforcement is through ANPR cameras and the trusted party to enforce the fine collection is through Sun&Belt which is also related to EPASS24.

In ***Belgium,*** the enforcement of the LEZ of Brussels is with ANPR cameras. To enter the LEZ of Brussels, vehicles (except national or Dutch) must register once before or on the day after entering the LEZ (free of charge) as the city does not have access to the vehicle technical data. The registration is valid for three years. If the vehicle does not comply with the LEZ, a day pass (€35) can be obtained. This pass can be obtained a maximum of 8 times a year.

The LEZ of Antwerp is also enforced with ANPR cameras. For Antwerp foreign vehicles, except Dutch, must register. Vehicles have to register once on or before the day after entry, and it is free of charge. The registration is also applicable for Ghent but not for Brussels.

In ***The Netherlands,*** the enforcement of the LEZ is done by ANPR cameras placed at the entry roads into the LEZ. Licence plates are photographed and digitized, after which the vehicle registration data is checked from the national registration database. Compliant vehicles will have their images deleted within 48 hours of registration. The city of Maastricht planned in 2018 a LEZ which triggered a problem because a lot of Belgium and German visitors come to Maastricht.

With Belgium there is a bilateral agreement in place for data exchange between the Dutch and Belgian national vehicle registration databases regarding vehicle owner/holder data. Technical support for the data exchanges is work in progress, so exchange is not yet possible. For the border city of Maastricht, the lack of enforcement method has caused the implementation of its LEZ to be on hold. The German authorities only provide information if a vehicle has been seen to make a violation, but for the enforcement of the LEZ, the information must first be checked to see if there is a violation (Wijers, 2020). The City of Arnhem suffers from an ANPR system that is not able to 'read' foreign license plates which makes foreign vehicle enforcement currently not possible.

In ***Germany,*** UVARs are manually enforced by verifying that a vehicle is compliant with local measures based on a sticker that is mandatory to place on the vehicle windscreen (Wijers, 2020).

In 2016 ***France*** introduced a national air quality certificate, CRIT'Air, for LEZs for all on-road vehicle types. Most cities, including Paris, have permanent LEZs. Many Departments (Region) and some cities such as Lyon and Grenoble have pollution emergency zones (Zones de Protection de l'Air) that can be in place when air pollution is above a threshold. Vehicles are only permitted to drive if the vehicle is compliant and has a sticker placed in the windscreen. The enforcement of France's LEZs is currently done manually (Wijers, 2020), although there is work at the national ministry level to enable some kind of camera enforcement.

In ***Hungary***, in the city of Budapest and some other large cities, specific vehicle types are prohibited to enter if there is a smog alarm. In Budapest, this applies to Euro 5 rating or lower and applies also to foreign vehicles. When a vehicle owner is not allowed to drive, he/she has free use of public transport by showing the vehicle registration. In Budapest there are also restricted zones for heavy-duty vehicles and green zones around historical sites etc.

A large number of cities in northern ***Italy*** have LEZs, usually covering the communal boundary. There are also emergency smog schemes, often at a regional level, that are, in pratice, in place most of the winter due to the high pollution levels. In many cities (mostly the old town centres) and on some islands

there are also Limited Traffic Zones (LTZ, and in Italian ZTL: zona a traffico limitato). On the roadside assistance the reader is warned that the rules are complex, differ per city and the fines are high. The general advice on the website is not to enter the zones with a vehicle if not necessary. There are also two urban tolling schemes in place. Every commune in Lombardia has a scheme - which is 1600 individual communes. Information on all these schemes can be found on the CLARS website.

In ***Ireland*****,** in Dublin there is an access regulation in place for lorries with 5 axels, daily active from 7:00-19:00. See also the website on Dublincitiy.ie. Enforcement is manual.

In ***Spain***, Madrid and Barcelona have an LEZ in place (*zona de bajas emisiones).* Admittance is only allowed with a sticker in place. Foreign vehicles cannot obtain the Spanish stickers. For Barcelona, vehicles registered outside Spain must register once before driving into the low emission zone. They have to register but are allowed to enter with other appropriate EU sticker, see sede.dgt.gob.es. Barcelona also enforces the LEZ by ANPR-cameras.

In ***Norway*****,** Oslo and Bergen have Environmental Emergency zones, however they are implemented as differential charging on their charging scheme. The city has a vehicle-free centre and is expanding this. Oslo, Bergen, and 5 other cities have a city toll in place, linked with the national main road tolling system. When the air quality is poor the city toll can be increased a maximum of 5 times and in addition, when needed on odd days only vehicles with an odd vehicle registration are allowed to enter the city and vice versa for even days. The toll collection is done by the national administration (Statens Vegvesen) and is an automated system with over 332 toll stations across the country. A toll tag can be used and if not the (foreign) vehicle owner will receive an invoice by post.

In ***Austria*** the Immissionsschutzgesetz – Luft (IG-L) allows LEZs to be implemented. This is done for lorries at a federal state level. The legal basis is the Emissions Class Labelling Ordinance (AbgKlassV). For the enforcement of vehicle drivers/operators must obtain a sticker (Abgasplakette), see (AbgKlassV (n.d.), Retrieved October 28, 2021). Currently, there are restrictions on freight traffic (categorie N) is in Vienna, Niederösterreich, Tirol, and parts of the Steiermark. The information regarding the LEZs sticker is available on the akkp.at website. The way foreign vehicles are enforced is not quite clear.

In ***Switzerland*****,** the Canton of Genéve has a temporary LEZ in place (*périmètre de circulation différenciée*) with a differentiated traffic scheme (Etat de Genève. (2021, July 2). Depending on the air quality there are 4 access levels for which you need a '*Stick'Air'* (GE.CH, 2020, January), French stickers are accepted.

3.3 Cross border data exchange

Cross border data exchange for LEZs is currently only possible where:

1. a bilateral agreement is in place (e.g., between Belgium and The Netherlands)
2. when entering a UVAR is seen as an offence (e.g., Sweden)
3. where the LEZ implemented through differential charging on an urban tolling (e,g., Norway)
4. where the national vehicle registration authority provides an open data feed on vehicle information (e.g., RDW in The Netherlands)
5. where third party 'debt collection agencies' are employed to find the information on both vehicle emissions and owner.

The cross border data exchange can be categorised in three different types of models:

- Authority centric model
- Driver centric model

- Vehicle centric model

This chapter presents a generic description of each model and chapter 4 provides a more detailed description of each model along with its related opportunities and challenges.

Authority centric model

In an authority centric model vehicle data and owner holder data is made available through the national vehicle registration authorities. Currently, several legal instruments enable exchange of vehicle or owner/holder data or both through EUCARIS, (for an overview of these regulations see chapter 3.5). These are either EU-wide or bilateral agreements between countries. This exchange started in the 1980s when many vehicles were stolen and exported. The agreements cover vehicle import/export, tracing vehicle status in regards to stolen vehicles, vehicles used in a crime, fines related to traffic safety, tolling etc. It is worth noting in terms of precedence, that for the import/export cases, vehicle technical data can also be exchanged before a transgression has been identified. Denmark, Norway and Sweden use these agreements to collect the toll through EPASS24 for the UVARs in place because the countries/cities combine these.

However, as it will be seen later, there is currently no EU-wide legislation or mechanism for obtaining vehicle and owner/holder data for enforcing UVARs such as LEZs. As previously stated, there is a Benelux a bilateral agreement in place, but technical support for the data exchanges is work in progress. Within EUCARIS two protocols are available to retrieve vehicle information and owner holder information. Different countries approach the cross-border exchange of information differently in the light of GDPR. Whereas the RDW in The Netherlands is the only country that shares all the vehicle data public and owner holder data through EUCARIS with all the European countries, on the other extreme, France has one of the most restrictive approaches to vehicle data, due to their interpretation of GDPR.

Through EUCARIS, the data exchange is technically possible, looking at the exchange of this information based on the legislation of bilateral agreement in place. However, not all countries register all relevant data needed for controlling vehicle access in their database. EREG is in the process of aligning this information (see chapter 3.4 of this document). Another aspect is that cities are not always connected to their vehicle registration authorities and in such cases, find it difficult to access relevant data.

Driver centric model

The Driver centric model is currently used by countries and or cities that use preregistration as a way to obtain the necessary information regarding the vehicle type and the owner holder data. Austria, France, Germany, Spain uses a national registration system where a windscreen sticker can be obtained for all the LEZs in the country. Either the vehicle data is taken from the national vehicle database, or the owner/holder has to register and upload proof regarding the vehicle. Barcelona uses stickers. The Spanish stickers have been sent to every vehicle owner by the national vehicle database, but the foreign vehicle owner/holder has to register for a sticker and pay a fee. As mentioned in the previous chapter in Belgium the registration to obtain access is done per city.

The Driver centric model relies on obtaining the information from the vehicle owner/holder, validating this with national data and then making this data available for cross-border exchange. Whether this information can be updated and for how long it is kept by relevant organization may differ in different countries. This also indicates some of the challenges related to this model. In practice, changing registration information or removing the information from the information holder is not or mostly not possible for the owner/holder.

The above paragraphs indicate how the Driver centric model is implemented/used at a national or city level in some countries. A more detailed description on the possible EU wide use of this model (through an approach similar to the COVID certificates) is provided in chapter 4.2. As it will be seen, the EU wide use of this model, would require the development of a technical architecture both at national and EU level before it can be operationalized.

Vehicle centric model – C-ITS

With the development of C-ITS services, it is technically possible that a vehicle identifies itself using data exchange with appropriate credentials. However, currently, a legal basis that can facilitate this possibility is missing. However, as detailed in chapter 3.5, some EU regulations are in the process of being revised and they may offer possibilities for a legal basis for this model. A drawback of this model is that the connected vehicle fleet that is equipped with this technique is rather small and are just in the segment that will comply with current LEZs. On the other hand, with the upcoming Zero Emission Zones (ZEZ) the vehicle-centric approach may become more valid. A retrofit onboard device could solve this problem. Tampering with the device should not be possible.

Vehicle centric model variant – Special license plates

In several European countries[1], vehicles with electric, gas, fuel cell or hydrogen propulsion can get or will have the possibility to get (in the near future) a special number plate. This is done for a number of reasons, including incentivising the use of these vehicles. This approach could also enable identification of compliant foreign vehicles for the purposes of enforcing the increasing numbers of zero emission zones (ZEZs, but not LEZs). However, such number plates would need to exist in every MS, the number plates must be able to indicate zero emission vehicles through ANPR (i.e., battery electric and fuel cell vehicles, and it may be that markers such as background colour as an indicator does not work for ANPR), and ideally a register of the different number plate formats to ease identification for ZEZs.

3.4 Vehicle registration

The EREG topic group XXI for Harmonising of Registration Procedures and Data Quality is currently working on the harmonisation of the vehicle datasets and quality. The European regulation (EU) 2018/858 describes an extended set of technical vehicle data that has to be delivered by the manufacturer in the Certificate of Conformity (CoC). This is mandatory as of 2026.
The TG XXI recognized the following issues (EREG,2020, July):

- Which of these data elements will be included in the vehicle registration data of the different Member States?
- Do we aim for some harmonisation between MS in the registered data set?
- If we aim for harmonisation: what are the reasons/criteria to register certain data? Or do we intend to store all CoC data?
- Should the registration of a certain data set and the exchange of these data be regulated and if yes, how? EU legislation or EUCARIS Treaty, or other?

The Goal of EREG topic group XXI is to determine a common dataset and describe the purposes of the registration in the Member States. First, the registration for M1 vehicles was analysed. Overall, 273

[1] These include Norway (letter combinations for electric vehicles are EL EK EV EB EC ED EE, hydrogen-powered HY, and gas powered GA), Germany (the letter E at the beginning or end for electric vehicles also includes plug-in-hybrid vehicles (PHEV)), Austria (the letter E), Poland (the background is light green instead of white), Latvia (start with EX), Switzerland (the same number plates as motorcycles), and the UK with green flash on the left-hand side.

data items relate to M1 vehicles. A questionnaire was sent out in 2020 to the Member States regarding the registration of vehicle data, where 13 Member States responded. It was possible to observe a significant difference between the Member States.

Table 2: Registration of data elements M1 (EREG, 2020, July)

Data elements (#)	Percentage of stored item by Member State (%)
11	100%
23	80%-99%
135	30-79%
66	1-29%
38	0%

EREG topic group XXI undertake an analysis of the definition of the different data elements. Some elements were ambiguous, like V.7 CO_2 emission value. This value can be taken by the NEDC of the WLTP test procedure, but also from other test procedures, and the data source needs to be standardised to be able to be used between different Member States. For other data elements the purpose of its inclusion in the registration data was not clear, and maintaining and keeping it up to date can take extra work for no clear purpose. Topic Group XXI members agreed that it is only valuable to store data if procedures are in place to keep the information up to date. For the data exchange (via EUCARIS AVI protocol) it was agreed to store at least the mandatory items from Directive 1999/37/EC, supplemented with items that are registered by more than 50% of the MS. The minimum data set using this definition for M1 contains 72 data elements. The dataset is not mandatory but hopefully will be the guideline for future developments.

3.5 Legal/Administrative challenges for sharing data relevant for UVAR enforcement.

The absence of a legal basis for cross-border exchange of data for enforcing UVARs has been identified in the survey conducted by the consortium as a key challenge by several cities and national ministries. This is true for both vehicle technical data as well as vehicle owner/holder data. Many cities have also indicated that the data relevant for enforcing UVARs is already shared between EU Member States in context of enforcing other laws (e.g., safety related traffic offences), however, this data is not shared with city authorities for the purposes of enforcing UVARs. In some cases, a reference has also been made by cities to commercial sensitivity and privacy being the reason for not sharing the data, as well as, lack of resources and/or priority for enforcing UVARs with respect to foreign vehicles.

Based on the survey held at the end of 2021 and first contacts, Table 3 indicates the responses and comments received from different cities with respect to legal and administrative challenges on sharing vehicle and vehicle owner holder data.

Table 3: Challenges related to exchange of vehicle and vehicle owner holder data

Country	City	Challenges related to the exchange of vehicle technical data and owner/holder data			
		No legal basis to exchange data in context of UVARs	Data is exchanged between countries in other contexts, but is not shared with city authorities for UVAR enforcement	Data is not shared as it is considered sensitive	Other Comments
Norway	Oslo				Extracting data on foreign vehicles requires authorization at national level. Bilateral agreements exist between Nordic

					countries, which can allow Norwegian authorities to request data either directly or through private companies. (Technical / Owner holder)
France	Strasbourg	Technical / Owner holder	Technical		
Hungary	Hungary			Technical / Owner holder	
Denmark	-	Technical / Owner holder	Owner holder		
Spain	Vitoria-Gasteiz		Owner holder		
Belgium	-	Technical	Owner holder	Owner holder	
Belgium	Antwerp	Technical			No legal basis except for France and The Netherlands (Technical / Owner holder)
Italy	Verona		Technical / Owner holder		
Germany	Bielefeld				
Belgium	Antwerp	Technical / Owner holder	Technical		Establishment of bilateral agreements can take a long time (Technical / Owner holder)
Germany	Aachen	Technical / Owner holder	Technical / Owner holder		
The Netherlands	Rotterdam	Owner holder	Technical / Owner holder		The Netherlands has bilateral agreements with Belgium, Germany and Switzerland. It is inefficient to have 26 agreements. (Owner holder)
The Netherlands	Zoetermeer	Technical / Owner holder	Technical / Owner holder		
The Netherlands	Amsterdam	Technical / Owner holder			
Spain	Barcelona Metropolitan Area		Technical / Owner holder	Technical	
Italy	Padova		Technical / Owner holder		
The Netherlands	-	Technical / Owner holder	Technical / Owner holder		
Belgium	Region of Flanders	Technical / Owner holder			

The statement about the 'absence of a legal basis to exchange data between Member States for enforcement of UVARs' is further examined.

For this, the existing legal instruments that are already used by EU Member States or that may have a bearing on exchanging vehicle and vehicle owner/holder data have been considered. These legal instruments can come in the form of *bilateral agreements* established by two Member States, *multilateral agreements* established by several Member States *and EU regulations/directives/initiatives* applicable to all Member States of the EU.

Some of the legal instruments listed below (especially bilateral agreements) can provide a direct basis for cross-border data exchange for UVAR enforcement. However, others only facilitate exchange of vehicle and vehicle owner/holder data for purposes other than UVAR enforcement. This chapter

highlights the challenges in applying these legal instruments to the specific case of UVAR enforcement and links them to the different data-sharing models described in chapter 4.

3.5.1 *Bilateral Agreements*

Overview	Status	Challenges for applying to UVARs	Relevant for
Several EU Member States (Belgium, The Netherlands, Germany, France, Luxembourg among others) have bilateral agreements with other Member States for the purposes of sharing vehicle and/or vehicle owner owner/holder information, which are sometimes also used for the purposes of enforcing UVARs. Notable examples of these agreements are the Conventions signed by Belgium with The Netherlands[2] and France[3], which facilitate exchange of both vehicle and vehicle owner/holder data between these countries for the purposes of enforcing UVARs.	In force	As such, there are no challenges to the use of bilateral agreements for exchanging data relevant for the enforcement of UVARs. However, given the number of bilateral agreements that will be required, this could bring added complexity and bifurcations in how UVARs are enforced across the EU.	Authority centric model, and Vehicle centric model

*3.5.2 **Multilateral** Agreements*

EUCARIS Treaty

Overview	Status	Challenges for applying to UVARs	Relevant for
Several EU Member States (Belgium, Finland, Germany, Latvia, Luxembourg, The Netherlands, Romania and Slovakia) and the United Kingdom of Great Britain and Northern Ireland, have established a multilateral agreement in the form of Treaty concerning a European vehicle and driving licence information system (EUCARIS).[4] The treaty establishes a common system for the exchange of vehicle and driving license data and puts it at the disposal of contracting parties as well as third parties wishing to exchange data on the basis of EU legal acts and bilateral and multilateral agreements. The purpose of EUCARIS is defined under the treaty in the following terms:	In force	The EUCARIS treaty by itself does not provide the legal basis for exchanging vehicle and vehicle owner holder data for UVAR enforcement. However, the framework established through the treaty can prove useful in case a legal basis is provided separatly from the treaty for exchanging data for UVARs.	Authority centric model

[2] The Treaty between the Kingdom of The Netherlands and the Kingdom of Belgium of 25 April 2013 on the cross-border exchange of information for the identification of persons suspected of having committed infringements in the context of the use of the road.

[3] The Treaty between the Government of the Kingdom of Belgium and the Government of the French Republic of 13 October 2008 on the exchange of information and personal data concerning holders of a registration certificate of vehicles entered in the national registration and vehicle registers, in order to penalise traffic offense.

[4] For text please see https://treaties.un.org/Pages/showDetails.aspx?objid=080000028059ee3b&clang=_en and https://treaties.un.org/Pages/showDetails.aspx?objid=080000028055d6fc&clang=_en

i. to ensure that the central vehicle and driving licence registers of the Parties are accurate and reliable; ii. to assist in preventing, investigating and prosecuting offences against the laws of individual States in the field of driving licences, vehicle registration and other vehicle-related fraud and criminality; iii. to exchange information rapidly in order to increase the efficiency of administrative measures taken by the relevant authorities according to the national regulations of the Parties; and iv. to be at the disposal for Parties or Third Parties wishing to exchange data based on an EU legal act or any bilateral or multilateral agreement other than this Treaty. In the context, EUCARIS can be used to exchange vehicle data and vehicle owner/holder data for purposes defined in the treaty, mainly for conducting checks during vehicle registration, issuance of driving licenses. It can also be used for exchanging this data in the context of any EU legal act (such as CBE, EETS directives) as well as for purposes defined in bilateral and multilateral treaty. The treaty allows for the exchange of data both *ex ante* (for preventing a transgression) as well as *ex post facto* (after a transgression has occured).			

Schengen Acquis - Decision of the Executive Committee SCH/Com-ex (99)11 Rev. 2

Overview	Status	Challenges for applying to UVARs	Relevant for
Several EU Member States, signatory of the Schengen Agreement, had established via *Decision of the Executive Committee SCH/Com-ex (99)11 Rev. 2* an agreement for cooperation to enforce road traffic offences, including infringement of road traffic regulations considered as administrative offences[5]. The agreement provided for exchange of both vehicle data as well as vehicle owner/holder data.[6]	Repealed	The law never came into force and has now been repealed.	Authority Centric model and Vehicle Centric model

[5] See Article 1 of the Decision of the Executive Committee SCH/Com-ex (99)11 Rev. 2

[6] See Article 3 of the Decision of the Executive Committee SCH/Com-ex (99)11 Rev. 2

The agreement was included within the framework of the EU Law, but was repealed in 2016 through Regulation (EU) 2016/94.			

3.5.3 EU Regulations and Directives

Directive (EU) 2015/413 – CBE directive

Overview	Status	Challenges for applying to UVARs	Relevant for
Directive (EU) 2015/413 or the CBE directive focuses on cross-border exchange of information on road-safety-related traffic offences. The key offences covered by the regulation include – speeding, failing to use a seat-belt, failing to stop at a red traffic light, drink-driving, driving while under the influence of drugs, failing to wear a safety helmet, the use of a forbidden lane, illegally using a mobile telephone or any other communication devices while driving. The CBE Directive plays a vital role in identification of owner, holder or driver of a vehicle and in follow-up proceedings where a penalty notice/information letter is delivered to the presumed offender.	In force, being revised	The scope of CBE directive is limited to traffic offences specifically mentioned in the directive. If the scope of CBE directive is expanded to include UVAR related offences, it may still not be able to address all the different types of UVARs, since not all UVARs are safety related Enforcement of some UVARs (such as LEZs) requires exchange of vehicle data as a first step to detect if a UVAR offence is committed and vehicle owner / holder / driver data as a second step. The CBE directive only facilitates exchange of vehicle owner/holder data after an offence is detected. It does not provide the basis for sharing vehicle data *ex ante*.	Authority Centric model

Directive (EU) 2019/520 – EETS directive

Overview	Status	Challenges for applying to UVARs	Relevant for
Directive (EU) 2019/520 or the EETS directive (among other things) lays down conditions necessary for facilitating cross-border exchange of vehicle registration data and data on owners or holders of vehicles for which there was a failure to pay road fees of any kind in the Union. Under the directive, it is possible to exchange information about a vehicle for which "failure to pay a road fee" has been established. In such cases, "data relating to vehicles" and "data relating to the owners or holders of the vehicle" can be shared by a Member State	In force	Fee-based UVARs could be covered within the current scope of the directive, however not all UVARs are fee-based. The directive allows for exchange of information only after "non-payment of road fee" has been established. This limits its use, as UVARs where vehicle data is required ex-ante (to check if a UVAR offence has been committed or not) are not covered.	Authority Centric model and Vehicle Centric model

only with the national contact point of the other Member State.[7]		Under the directive, data can be shared only with "national contact points" or with "entity responsible for levying the road fee". In view of this, city authorities may face some challenges to request data for enforcing UVARs as they may have to prove that they are an "entity responsible for levying the road fee". Also, cities often use contractors or other agencies to operate these schemes, which can be an additional complexity. The overall purpose and scope of the directive is not specifically related to UVARs and this can make it difficult to appropriately justify its use for UVAR enforcement, even though both vehicle and vehicle data can be shared for enforcement of fee based UVARs.	

Directive (EU) 2014/45-46-47–Roadworthiness Package

Overview	Status	Challenges for applying to UVARs	Relevant for
This roadworthiness package includes 3 directives which lay down the provisions for periodic testing of vehicles, roadside inspection for commercial vehicles and electronic recording of data related to vehicles. Directive (EU) 2014/45 – includes a reference to facilitating exchanges of information between countries, through designated national contact points, on data relating to roadworthiness testing and odometer readings between the competent authorities of Member States responsible for testing, registration, and vehicle approval, testing centres, test equipment manufacturers and vehicle manufacturers. Directive 2014/46/EU – focuses on electronic recording of information on vehicles, to reduce administrative burdens and ease of	In force, being revised	The package is focused on electronic storage and cross-border exchange of safety-relevant vehicle data, however not all UVARs are safety related. Though the package has facilitated electronic recording of both technical vehicle data as well as vehicle owner/holder data, it is not clear if the latter can currently be shared between Member States within the current scope of the directive and without the directive being adapted.	Authority Centric model, Driver Centric model and Vehicle Centric model

[7] See Article 23 of the Directive

exchanging information. It amends Council Directive 1999/37/EC of 29 April 1999 on the registration documents for vehicles to add that Member States shall record electronically data on all vehicles registered on their territory. The data to be recorded electronically includes – technical vehicle data as well as vehicle owner/holder data. A study on the effectiveness of roadworthiness package conducted by the European parliament in the year 2020, has found that the majority of Member States are maintaining the data in electronic format.[8] Directive 2014/47/EU – focuses on cooperation and exchange of information in the context of roadside inspections. It establishes national contact points and obliges Member States to share information with other Member States on any major or dangerous deficiencies found in vehicles. Currently there is an exercise to revise roadworthiness package ongoing.[9] The following changes are being considered to directive 1999/37/EC: New provisions: 1. Electronic storage of registration certificates and vehicle data in national databases and granting electronic access to relevant data to the registration authorities of other EU MS, by means of interlinking national databases 2. Add new data to the vehicle register database and ensuring that these are continuously updated and accurate • Odometer data and odometer history data • Major accidents • Vehicle status (e.g., de-registered, temporarily de-registered, suspended, exported, end-of-life, destructed,) 3. Introduce the option of registration certificates in digital format (Annex I) 4. Provisions for preparing for the full digitalisation of the registration documents			

[8] https://www.europarl.europa.eu/RegData/etudes/STUD/2020/654175/EPRS_STU(2020)654175_EN.pdf (see Table 8)

[9] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13132-Vehicle-safety-revising-the-EU%E2%80%99s-roadworthiness-package_en

Improving or extending existing provisions: 1. Harmonisation of the technical data in the vehicle registration documents 2. Improve administrative processes • Re-registration of vehicles • Dealing with End-of-life vehicles			

Regulation (EU) 2019/631 – CO_2 emission performance standards for vehicles

Overview	Status	Challenges for applying to UVARs	Relevant for
Regulation (EU) 2019/631 establishes CO_2 emissions performance requirements for new passenger cars and for new light commercial vehicles to contribute to achieving the Union's target of reducing its greenhouse gas emissions, as laid down in Regulation (EU) 2018/842, and the objectives of the Paris Agreement and to ensure the proper functioning of the internal market. Article 12(1) of the Regulation stipulates that the Commission shall monitor and assess the real-world representativeness of the CO_2 emissions and fuel or energy consumption values. Accordingly, the Commission has adopted Implementing Regulation (EU) 2021/392 laying down rules for monitoring and reporting data relating to CO_2 emissions and energy consumption with respect to these vehicles. The implementing act requires Member States and vehicle manufacturers to share real world emission data as well as the Vehicle Identification Number (VIN) with the commission and European Environment Agency.	In force	Though the regulation and implementing act create a repository at the EU level of data that maybe relevant for enforcement of UVARs such as LEZs, this data cannot be used for this purpose. The regulation and the implementing act limit the use of this data for the purposes stipulated in Article 12(1) of the regulation i.e. assessment of CO_2 emission and energy consumption and their evolution overtime to help achieve targets set out in Paris Agreement.	Driver Centric model

Directive 2010/40/EU – ITS Directive

Overview	Status	Challenges for applying to UVARs	Relevant for
Directive 2010/40/EU or the ITS Directive establishes a framework for coordinated and coherent deployment and use of Intelligent Transport Systems (ITS) within the Union, in particular across the borders between the Member States. Based on the directive, the Commission has introduced legally binding specifications for	In force, being revised	The scope of ITS directive and its delegated regulations is limited, and the data exchange fostered by them is essentially for the purposes stipulated in those documents. The RTTI delegated regulation which focuses on exchange of data by road authorities, road	Vehicle Centric model

interoperability and continuity through delegated acts, as well as developed some necessary standards. Further, the Commission has adopted guidelines and other non-binding measures. The delegated acts related to ITS Directive focus on the priority areas listed in the directive: Commission Delegated Regulation (EU) 2017/1926 – EU-wide multimodal travel information services (MMTIS) Commission Delegated Regulation (EU) 2015/962 – EU-wide real-time traffic information services (RTTI) Commission Delegated Regulation (EU) No 885/2013 – Information services for safe and secure parking places for trucks and commercial vehicles (SSTP) Commission Delegated Regulation (EU) No 886/2013 – road safety-related minimum universal traffic information free of charge to users. (SRTI) Commission Delegated Regulation (EU) No 305/2013 – interoperable EU-wide eCall Currently a revision of RTTI is underway and some new provisions may be included in the regulation[10]. • *First* its geographical scope maybe expanded to apply to entire road network and not just to TEN-T. This would include urban areas. • *Second* new data types maybe included within its scope such as location of service areas and rest areas; location of refuelling points and stations for all other fuel types; weight/length/width/height restrictions; one-way streets; boundaries of restrictions, prohibitions; or obligations with zonal validity, current access status and conditions for circulation in regulated traffic zones. UVARs are one of the priority data aspects to be included. If the scope of the RTTI delegated regulation is expanded, it may become relevant for		operators and service providers includes within its scope data related to road signs with respect to traffic regulations (such as UVARs). This in theory can facilitate compliance with UVARs. However, the regulation does not focus on exchange of vehicle data or vehicle owner/holder data for enforcement purposes. Currently, the RTTI delegated regulation is also limited in its geographical scope and applies only to Trans European Transport Network (TEN-T).	

[10] https://uvarbox.eu/wp-content/uploads/2021/09/UVARBox_WS3_Presentation-on-revision-of-ITS-Directive-and-DR2015-962.pdf

facilitating communication between connected vehicles and road transport infrastructures, for the purposes of UVAR enforcement. See the vehicle centric model discussed under chapter 4.3 of this document. A framework for such communication has been established by several different entities (including vehicle manufacturers, government entities among others) to share and exchange data for the purposes of road safety. This has been done within the umbrella of SRTI regulation.			

Regulation (EU) 2018/1724 - establishing a single digital gateway

Overview	Status	Challenges for applying to UVARs	Relevant for
Regulation (EU) 2018/1724 facilitates online access to information, administrative procedures, and assistance services that EU citizens and businesses may need in another EU country. It also lays down rules for the use of procedures by cross-border users and the implementation of the 'once-only' principle. Among the procedures listed in the Annex II to the regulation, reference is made to procedures for *"Obtaining stickers for the use of the national road infrastructure: time-based charges (vignette), distance-based charges (toll), issued by a public body or institution"* and *"Obtaining emission stickers issued by a public body or institution"*. Section 2 of the regulation (consisting of Articles 13 to 15) provides for establishment of a technical system by the Commission for automated exchange of evidence to complete (among others) above procedures. Under section 2, competent authorities from Members States are obliged to share relevant evidence with competent authorities in other Member States to facilitate completion of the above procedures, if such evidence is in electronic format that allows for automated exchange. Efforts to develop an implementing act and initiatives such as the TOOP project are ongoing to facilitate the development of the	In force	The single digital gateway regulation provides a legal basis for exchange of relevant evidence (e.g., vehicle data and vehicle owner holder data) between competent authorities. However, this exchange is limited to cases where UVARs are enforced with respect to foreign vehicles through issuance of stickers / vignette. In these cases, based on regulation SDG regulation, cross-border users should be able to obtain stickers/vignettes by submitting necessary evidence online. Also, competent authorities from two countries should be able to exchange necessary information to verify the evidence submitted by a user and issue the sticker/vignette.	Authority Centric model

technical system. Where other systems are not available or applicable, then competent authorities are obliged (as per Article 15) to exchange evidence through the Internal Market Information system (IMI).[11]			

Regulation (EU) 2021/953– on framework for issuance, verification and acceptance of interoperable COVID-19 certificates

Overview	Status	Challenges for applying to UVARs	Relevant for
Regulation (EU) 2021/953 is the basis for the EU Digital COVID-19 Certificate framework and allows for the issuance, cross-border verification, and acceptance of different kinds of certificates issued by different authorities across EU within the context of COVID-19 Pandemic. The regulation also establishes a trust framework for the reliable and secure issuance and verification of the authenticity, validity and integrity of the certificates. The regulation does not directly apply to UVARs. But it provides a legal basis necessary for the architecture of the Driver Centric model described in chapter 4.2. Under this model UVARs would be enforced using digital credentials that are issued to vehicle owner/holders and are accepted across the EU. The digital credentials would contain relevant data necessary for the enforcement of UVARs.	In force	The architecture described in Regulation (EU) 2021/953, would have to be specifically adapted for the issuance and recognition of digital credentials to share vehicle data as well as vehicle owner/holder data. The adapted regulation would have to streamline the issuance of digital credentials by Member States and describe measures to ensure that the data in the digital credential is correct and up to date.	Driver Centric model

European Digital Identity wallet initiative

Overview	Status	Challenges for applying to UVARs	Relevant for
The Commission has proposed a framework for a European Digital Identity, which will be available to all EU citizens, residents, and businesses in the EU. Citizens will, in the future, be able to prove their identity and share electronic documents from their European Digital Identity wallets.	Being implemented	The use of digital wallet initiative in the context of UVAR enforcement will be relevant in the event UVARs are enforced using a Driver centric model described in chapter 4.2, where digital credentials are issued (to vehicle owner/holders) that are readable across EU by different competent authorities and contain	Driver Centric model

[11] See below the chapter on IMI.

The European Digital Identity wallets initiative builds on the existing cross-border legal framework for trusted digital identities, the Europeans electronic identification and trust services initiative (eIDAS Regulation). Though the eIDAS regulation provides the basis for cross-border electronic identification, authentication and website certification within the EU, it does not contain any obligation for Member States to provide their citizens and businesses with a digital identification system enabling secure access to public services or to ensure their use across EU national borders. Nor does it contain provisions regarding use of such identification for private services, or with mobile devices. This leads to discrepancies between countries, where some countries provide it, and others do not. Under the new initiative everyone will have a right to obtain a European Digital Identity Wallet which is accepted in all Member States. Citizens will be able to use it for a range of different public and private services, who will be obliged to accept it.[12] Though the initiative is not directly related to facilitating cross-border exchange of data, it bears relevance for a Driver Centric model described in chapter 4.2, where it would be possible for vehicle owners/holders to obtain a digital credential readable across EU by different competent authorities and containing all the data relevant for enforcing UVARs. The digital wallet could be extended to contain all mobility related data that maybe required by citizens to ensure smooth and free movement across EU.		all the data relevant for enforcing UVARs.	

Data Governance Act and Data Act

[12] https://ec.europa.eu/commission/presscorner/detail/en/QANDA_21_2664

Overview	Status	Challenges for applying to UVARs	Relevant for
The data governance act, data act and creation of European common data spaces (including for mobility) are initiatives that emerge from the EU data strategy. The proposed text of data governance act focuses on re-use of data available with public sector bodies and lays down a framework for data intermediaries and providers of data sharing services. The proposed text of data act lays down harmonised rules on making data related to the use of a product/service more accessible to the users of the product/service as well as to third parties.	Draft proposal	The data governance act as well as the data act are both horizontal legislations and are not sector/use-case specific. Neverthless they have implications for harmonizing data sharing processes making it more accessible and in shaping the creation of common data spaces in EU.	Driver Centric and Vehicle Centric models

Prüm Treaty and Council Decisions

Overview	Status	Challenges for applying to UVARs	Relevant for
Council Decision 2008/615/JHA and Council Decision 2008/616/JHA transpose the basic elements of the Prüm Treaty into EU law to combat cross-border crime and terrorism. The decisions foster cross-border cooperation and automated exchange of information between authorities responsible for the prevention and investigation of criminal offences and establish the necessary administrative and technical provisions for the same. Exchange of vehicle registration data (both vehicle as well as vehicle owner/holder data) via EUCARIS is included within the framework of the council decisions. They allow for the exchange of data both *ex ante* (for preventing a criminal offence) as well as *ex post facto* (for investigating a criminal offence).	In force	UVARs are not categorized as criminal offence.	Authority centric model

4. UVAR Enforcement data-sharing models and related challenges

This chapter provides an overview of different *data sharing models* (i.e., authority centric, driver centric and vehicle centric) as well as some of the *technical tools* that can facilitate the exchange of data for UVAR enforcement purposes.

For the *authority centric model* there is already a technical tool in the form of EUCARIS available, providing many/all components that can facilitate the implementation and use of the model for sharing both vehicle and vehicle owner/holder data. The Internal Market Information System (IMI) tool developed by the Commission can also be useful for implementing this model.

For the *driver-centric model*, several technical components have been developed and are being used in the health-sector for COVID-19 certificates, but they have not been used and applied in transport domain and hence would need to be adapted. The IMI may also be able to play a role in implementing this model.

Similarly, for the *vehicle-centric model there are* technical components available and being used for the purposes of data-sharing for road safety, but the same is currently not feasible for the purposes of UVARs. The vehicle-centric model variant – special number plates – is currently in place for some MSs.

4.1 Authority-centric model (EUCARIS):

4.1.1 Pre-requisites

This model requires:

- A software application for digitally exchanging data in standardized formats.
- Existence of national contact points designated by Member States who can communicate with each other through the software application (such as vehicle registration authorities or entities linked to vehicle registration authorities).
- Legal basis for exchanging data (in the form of bilateral agreement/multilateral agreement/EU law).

4.1.2 Availability

The pre-requisites for this model are already available through the European car and driving licence information system (EUCARIS). Member States are already applying this model (through EUCARIS) in the context of several EU laws (such as CBE and EETS). It is also used by some Member States for UVAR enforcement (including LEZs) based on bilateral agreements.

4.1.3 Key Features

- The model focuses on connecting vehicle registration authorities in Member States to share different types of data related to vehicles and vehicle owners/holders for the purposes of law enforcement.
- Each Member State has a national contact point, which provides relevant information upon requests received from counterparts in other Member States. This national contact point is an officially designated entity in each Member State.
- The information is shared via standard data model, using bilateral/multilateral agreement or EU law as the legal basis to share relevant information.

- EUCARIS provides all the elements necessary for the functioning of this model and is used by all Members States as a means of data exchange for a range of different EU laws, for example the CBE directive, the EETS Directives and regulation on sharing data of certificates of conformity stipulate the use of EUCARIS to exchange information within the framework of those directives.
- For EUCARIS several Member States have designated their national vehicle registration authorities as the national contact point, but in other Member States this role is played by another entity, linked to the vehicle registration authorities.
- Both vehicle and vehicle owner/holder data are being exchanged through EUCARIS for a range of different issues:
    - *Vehicle data* is being exchanged to tackle VAT fraud, to retrieve roadworthiness certificate, certificates of conformity and for vehicle re-registration purposes.
    - *Vehicle owner/holder data* is being exchanged in the context of enforcing road safety offences under CBE directive, and payment of road fee under EETS directive etc.
- EUCARIS is also being used by some Member States (e.g., Belgium/The Netherlands/Luxembourg) to exchange vehicle data and vehicle owner data bilaterally to enforce UVARs.

4.1.4 How it Works

In the context of UVARs, and where a bilateral agreement exists between countries for sharing data relevant for UVARs, a 2-step procedure is followed:

- In STEP 1, a request message containing a vehicle licence plate number, the country code where the vehicle is registered, and a reference date (e.g., the date and time a vehicle was observed entering an environmental zone) is sent to national contact point of the country where the foreign vehicle is registered. A response is then received containing the technical vehicle data.

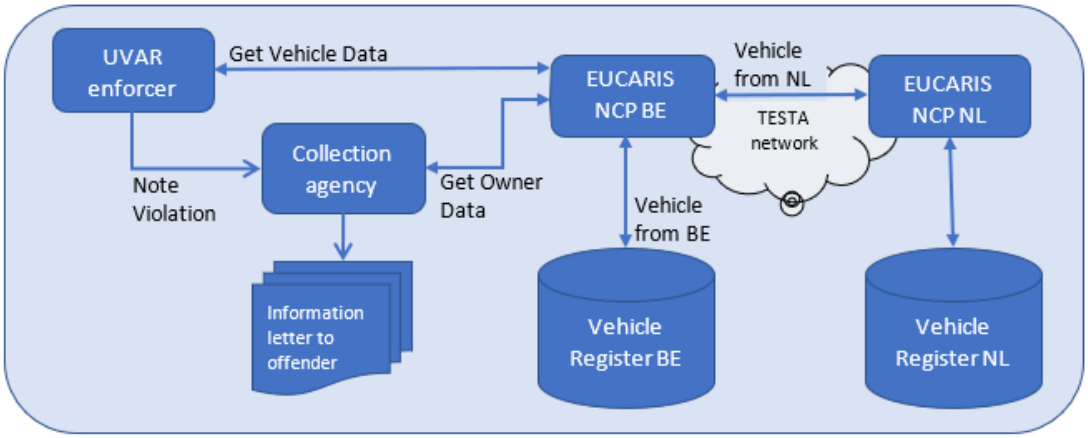
  Attributes such as vehicle category, age of the car, fuel, emission class, electrical/hybrid vehicle indicators etc. can be exchanged in this step. In future versions of request and response messages between national contact points provided by EUCARIS it will also be possible to exchange data such as the vehicle mass, dimensions and emission parameters.

- In STEP 2, a request for the vehicle owner/holder data is made and answered with respect to the foreign vehicle infringing a UVAR. This information can be collected through the Vehicle/Owner/Holder Information (sVHOH) XML[13] Message Specification of EUCARIS. The request can be made based on chassis number (VIN) or licence plate number combined with reference data and time.

The schematic dataflow diagram below indicates the use of EUCARIS in the UVAR enforcement process between Belgium (BE) and The Netherlands (NL) who have a bilateral agreement to share vehicle and vehicle owner/holder data for UVAR enforcement. In the diagram below, “EUCARIS NCP” means the EUCARIS national contact point.

[13] This term describes the format in which the messages are sent on EUCARIS platform.

Figure 1 – Data sharing under authority centric model



4.1.5 Opportunities/Challenges

Organisational	
Opportunities	Challenges
EUCARIS is already being used by all EU Member States in the context of different EU regulations and directives to exchange vehicle data as well as vehicle owner data.	
EUCARIS can be used to both identify vehicle technical data as well as to identify vehicle owner/holder.	
Use of EUCARIS does not require registration as a pre-requisite on part of a driver/holder of a vehicle. It can therefore be used to identify vehicle/owner holder of an infringing vehicle under all circumstances and even when a foreign vehicle owner/holder does not register with a city for UVAR purposes.	
Best usage of EUCARIS platform for UVARs is seen in cases where cities can directly connect to the platform to make vehicle data requests for checking if a UVAR offence has been committed and then for obtaining vehicle owner/holder data to issue fines. This is the case, for example, between Belgium and The Netherlands, where Belgian cities/municipalities can directly have access to vehicle data and subsequently also obtain vehicle owner/holder data from the Netherlands through the EUCARIS platform.	On EUCARIS platform the exchange of data usually occurs at the level of national contact points, and city/local authorities who would need the data to enforce UVARs, may not always have direct access to this data in some countries. Whether the data is shared with the city/local authorities depends on systems in place in each country. It is for each country to setup a system through which local authorities access the relevant data via their national (EUCARIS) contact point. In some countries, cities cannot access data on foreign vehicles due to data protection/privacy concerns. To overcome this challenge and to facilitate access to data relevant for UVAR enforcement, countries such as UK allow city/local authorities to demonstrate that they can manage data responsibly, robustly, securely, rigorously, accounting for data protection issues. Once this has been demonstrated in a manner that no

	legal issues will arise, city/local authorities are granted a special status and are allowed access to the data.
	Vehicle data relevant for UVARs (e.g., EURO norms) may not always be available with national registration authorities. Updated vehicle/owner holder data may also be sometimes missing.[14] The poor quality of data available in vehicle registers has also been identified as a challenge under the impact assessment study being conducted for the CBE directive.[15] However, the challenge of inaccurate vehicle data can be overcome by making approximations through co-related data. Eg. The emission standards of the vehicle can be approximated by using the age and vehicle type.
Legal	
Opportunities	Challenges
Currently, EUCARIS platform allows the possibility of sharing a dataset for which no specific legal basis is required. This data set is categorized as "non-sensitive vehicle data" and can include technical vehicle data for the purposes of enforcing UVARs.	However, as there is currently no clear legal basis at the EU level that supports exchange of "non-sensitive vehicle data", currently such data can be exchanged only through bilateral/multilateral agreements, which can be limited in their scope. Access to data contained in national registers by non-domestic authorities is a sensitive issue for some countries, in particular if this data is personal (vehicle data can be considered as personal in certain countries and owner data is generally considered as personal). An EU-wide framework would thus be needed to enable this exchange.
Technical	
Opportunities	Challenges
There are no technical challenges or problems with accessing the vehicle technical data or vehicle owner/holder data. Standardized data exchange protocols are available and documented. These are easy to implement as they are also compliant with current practices within CBE and EETS.	-
Misc. (Non Essential)	
Opportunities	Challenges

[14] See chapter 3.4 of this document above.

[15] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/2131-Cross-border-enforcement-of-road-traffic-rules_en

Information on exemptions that can be discerned from the vehicle data (e.g., off road vehicles) can be made available to enforcers through EUCARIS.	Data in vehicle registers does not include information on non-vehicle-based exemptions to a UVAR (e.g., disabilities or commercial transport). It may thus not be possible to share these, through EUCARIS platform. However, the ongoing revision of Directive 1999/37/EC, could be an opportunity to include this data in the vehicle registers, which could then be exchanged via EUCARIS.

4.2 Driver-centric model:

4.2.1 Pre-requisites

This model requires:

- Designated authorities (issuers) at the national level to issue a digital credential containing data relevant for UVAR enforcement (either vehicle registration authorities or entities linked to vehicle registration authorities).
- A system for the authorities above to issue the digital credential.
- A trust framework (Verifiable Registry) at the EU level to authenticate, store and provide access to digital credentials.
- Backend systems at city/enforcement authorities' level to read and interpret the digital credentials in the context of local rules.
- Legal basis for above-described technical components and for drivers to obtain as well as share digital credentials for UVAR enforcement.

4.2.2 Availability

The model and its technical architecture are already operational and proven in the context of the EU Digital COVID-19 certificate (sanitary pass), but it is yet to be adapted for UVAR enforcement purposes. IN Groupe, a government owned entity in France, has been a stakeholder of this model in the context of the COVID-19 certificates. It has also been proposing the use of this model in other areas including enforcement of UVARs with respect to foreign vehicles.

4.2.3 Key Features

- The approach of this model is similar to EU approach on issuance and verification of individual COVID – 19 related certificates that are issued locally/nationally and are accepted internationally to regulate access of individuals to different spaces.[16]
- Under this model, if an architecture similar to the COVID-19 certificates is established, then vehicle owner/holder/driver could directly share the data relevant for enforcing UVARs with city authorities through a digital credential issued to them.

[16] The EU Regulation on COVID certificates - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0953

- Though the model would require registration and consent on part of the vehicle owner/holder/driver to share the information, the number of registrations required would be reduced, as the digital credential once issued would be accepted across EU.
- The model would foster compliance with UVARs by allowing willing or compliant drivers / owners to share information with city/enforcement authorities directly. This could reduce efforts on part of city authorities, as they would have to liaise with national or foreign vehicle registration authorities only for those vehicles which do not have or share the digital credential.

4.2.4 How it works

- **The technical architecture** of this model requires four main actors –
    - *Issuer(s)*: These are entities in the vehicle's home country (i.e. country where the vehicle is registered), who in coordination with the national vehicle registration authority issue a digital credential containing information relevant for enforcing UVARs.
    - *Holder(s)*: These are vehicle owner(s)/holder(s)/driver(s) to whom the digital credential is issued.
    - *Verifiable Registry*: An entity at EU level which provides the trust framework to prove the authenticity of digital credentials. This EU level entity is also a repository of all the digital credentials issued across the EU and can share them with city/enforcement authorities for facilitating automated checks. This entity also hosts the applicable and dynamic UVAR rules (those applicable at a specific time for a specific location, for example when there's a pollution peak).
    - *Verifier(s)/enforcement authorities*: These are the city/enforcement authorities who check vehicles and their associated digital credentials for UVAR compliance, either through physical controls or Automatic Number plate recognition (ANPR).

- **The issuance of digital credential** would require designation of entities as issuer(s) at national level by all Member States. These entities can either be vehicle registration authorities themselves or would need to maintain a close link with vehicle registration authorities, to issue authentic digital credentials containing data from a trusted initial source. The digital credential would be issued once – either at the time of vehicle registration or upon request of vehicle owner/holder. Given the link with vehicle registration authorities, it would be possible to deactivate or renew the digital credential when the vehicle is sold/reported stolen/registered in another country/scrapped. The digital credential would contain all the data necessary for enforcing a UVAR (i.e. both vehicle and vehicle/owner holder data). It would also be linked to the vehicle number plates.

- **The recognition of the digital credential** by city/enforcement authorities across all EU Member States would require the establishment of a trust framework at the EU level, in the form of a Verifiable Registry. The Verifiable Registry would receive information from issuer(s) in different countries on public keys[17] and share it with city/enforcement authorities across EU, so that the authenticity of digital credential can be verified.

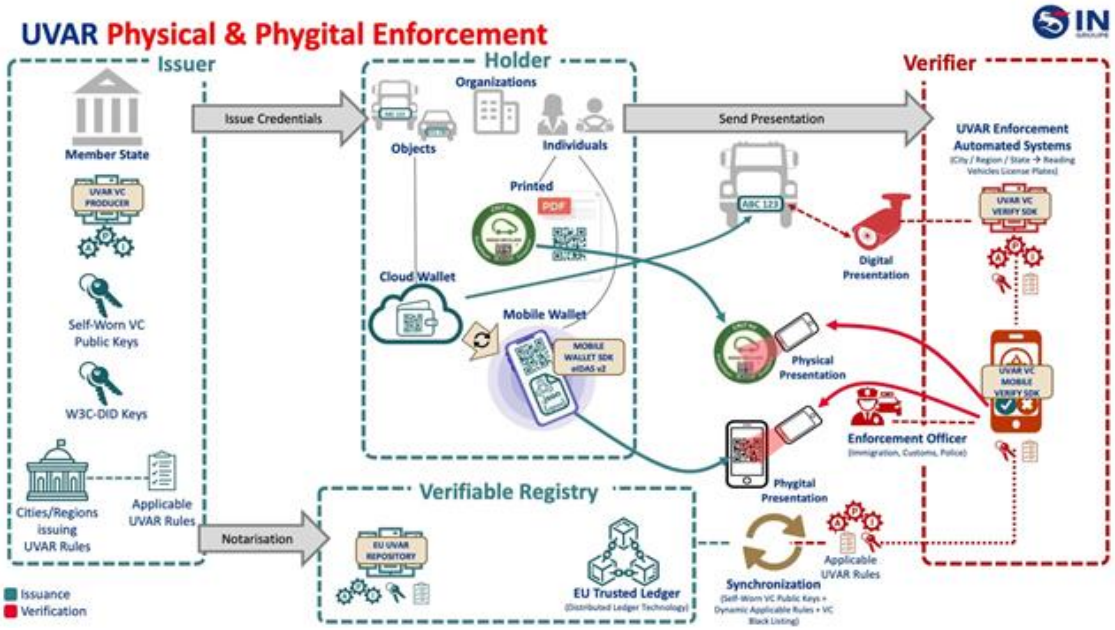
[17] The reference to public key here is in the context of X509 cryptography or Distributed Identifiers (DID) in the context of Self Sovereign Identity (SSI) model. The role of public key in this model is to allow external parties to verify that the document is authentic and has been issued by an accredited issuing authority.

- **Sharing the digital credential** would be possible in different ways.
    - First it would be possible to have the digital credential in different forms, it could be used to generate a QR code, be stored in a mobile wallet (in the hands of the owner/driver) as well as a cloud wallet (this wallet being linked to the object/vehicle/vehicle number plate itself, for example when multiple drivers use the same vehicle) and take the form of physical stickers and/or pdf document.
    - Vehicle owner/holders could share it directly with city/enforcement authorities during physical roadside checks.
    - For automated checks relying on automatic number plate recognition (ANPR), the Verifiable Registry at the EU level (as a repository of all digital credentials issued across EU) would allow cities to directly access the digital credentials related to a foreign number plate. This could happen on the basis of consent provided by the vehicle owner/holder at the time a digital credential is issued to them OR alternatively through a law (preferably at the EU level) allowing cities to access the digital credentials available with the Verifiable Registry.

- **Reading the digital credential** would be made possible by establishing a back-end system for city/enforcement authorities.
    - For physical/roadside checks the back-end system will leverage a Software Development Kit (SDK), allowing the enforcement officer to have a mobile application to scan the digital credential (QR code) and obtain the necessary information.
    - For automated checks through ANPR an application programming interface (API) would be required to match the digital credential (shared digitally or accessed through Verifiable Registry) with vehicle number plate, and owner information for those registered.

The figure below provides an overview of the actors and processes involved:

Figure 2: Data sharing under driver centric model



4.2.5 Opportunities/Challenges

Organisational	
Opportunities	Challenges
This model avoids the need for users to perform multiple registrations, in different countries and cities. The digital credential would be issued once (either at the time of purchase, resale of a vehicle or at the owner's/holder's request) and can be used to provide relevant data directly to city/enforcement authorities across Europe.	The model relies on registration by the vehicle owner/holder to obtain the digital credential and their willingness to share data through this modality with the city/enforcement authorities. If no registration is done to obtain the digital credential and data is not shared by the vehicle owner/holder, then the challenges we encounter today would continue to apply. Getting all drivers in Europe to be aware of the need to register and obtain the digital credential will also be a challenge. To over-come this challenge some steps could be taken: o Obtaining a digital credential could be embedded in the process of selling /purchasing vehicles. o Similarly, opportunities to easily obtain the digital credential could be set-up for vehicles already in circulation. o Obtaining the digital credential could also be made mandatory through national laws. o At EU level, non-registration of a vehicle/absence of a digital credential could be categorized as an infringement that would allow countries to request data about the infringing foreign vehicle via mechanisms such as EUCARIS.
As the data under this model would be shared directly by vehicle/owner holder through digital credentials, the vehicle registration authorities, would not have to answer data requests for foreign vehicles each time such vehicles enter a UVAR zone. Such data requests would be made only for those vehicles who have failed to register and obtain digital credential, or have failed to share the same with city authorities.	The vehicle registration authorities would need to be involved with the issuance of the digital credentials.
	In order to identify owner/holder data for those who do not register, the solution needs to be combined with another system to offer complete enforcement – otherwise by not registering, the vehicle could avoid compliance, reducing the incentive for registration.
Legal	
Opportunities	Challenges
For its architecture, the model could leverage the Regulation (EU) 2021/953 on a framework for the	The model requires a legal basis for its architecture:

issuance, verification and acceptance of interoperable COVID-19 vaccination, test and recovery certificates (EU Digital COVID Certificate).	• to establish/designate entities that will issue the digital credentials at the national level in all Member States, • to establish a trust framework at EU level for verifying authenticity of digital credentials issued by each Member State, • to streamline and standardize the technical aspects related to the architecture across the EU. The model requires a legal basis for drivers to obtain as well as share digital credentials for UVAR enforcement.
As local UVAR enforcement authorities could access the data required directly from the digital credential to check for UVAR offences (for registered vehicles): • the model would not require an international legal basis for data sharing and establishing connections between national vehicle registration authorities in different countries. • the model also would not require a legal basis at the national levels to help local UVAR enforcement authorities to connect to their national vehicle registration authorities for accessing foreign vehicle data.	
The model could leverage the ISO/IEC 18013-5:2021, which establishes interface specifications for the implementation of a driving license in association with a mobile device. This document specifies the interface between the mobile driving license (mDL) and mDL reader and the interface between the mDL reader and the issuing authority infrastructure. This document also enables parties other than the issuing authority (e.g., other issuing authorities, or mDL verifiers in other countries) to: • use a machine to obtain the mDL data; • tie the mDL to the mDL holder; • authenticate the origin of the mDL data; • verify the integrity of the mDL data.	
The revision of the roadworthiness directive where the issuance of digital registration certificates is being considered could also be useful for this model.	
Technical	
Opportunities	Challenges
Several technical components of the architecture required for this model are already available and have been deployed in the context of issuance and recognition of COVID-19 certificates in the EU (aka EU Digital COVID Certificate / EU-DCC). For a rapid implementation combined with progressive scalable deployment, the whole model can leverage both the EU-DCC proven robust and	The model has not so far been used for vehicle or owner/holder data. The deployment of this model would entail the establishment of an architecture with different elements including – issuing authorities at national level, verifiable registry at EU level and back-end system for city/enforcement authorities.

efficient model, and state of the art latest open standards (W3C-DID, W3C-VC) for the implementation of a Self-Sovereign Identity based model, which can be categorized as an evolution over centrally managed models to a model where the user (aka the holder of the digital credential) is empowered and controls the way his/her information is managed.	All countries in the EU that (will) have LEZs or other UVARs, would have to be willing to participate in this new to deploy system and would also have to standardize rules and procedures for the system to work effectively.
For the trust framework at the EU level, the work done under the EU C-ITS Security Credential Management System (EU CCMS) could also be leveraged.	
Misc. (Non Essential)	
Opportunities	Challenges
A functionality could be added so that enforcers would not have to analyse the data contained in the digital credential in light of the local city rules. Instead, an application behind the scenes will do this for them and simply indicate if the vehicle visiting their city is complying or not, by interpreting the data from the digital credential in light of the local rules.	
A functionality could be added where digital credential system could be used by vehicle owner/holder to gain prior knowledge about different rules/UVARs across different EU cities, and to know what cities/zones the vehicle can or cannot access. This functionality could be added by linking the digital credential to navigation applications/systems used by the vehicle that contain the UVAR data or directly through DATEX II data on the NAPs (UVARBox).	
Under this model, it would be possible to incorporate data related to exemptions that cannot be discerned from vehicle data (e.g., for disabled people or for transport companies).	
This model could leverage and be integrated into the European digital identity and digital wallet framework, in the frame of eIDASv2, where the digital credential could be kept by users in the digital wallet and be linked to their digital identity.	

4.3 Vehicle-centric model:

4.3.1 Pre-requisites

The model requires:

- Connected vehicles whose relevant data can be accessed by third parties.
- Dedicated platform to authenticate and give access to data from the vehicle.
- Infrastructure at the city level to access relevant data from the vehicle/dedicated platform.
- Legal basis to facilitate this data sharing.

4.3.2 Availability

The possibility to collect and store digital vehicle data already exists, however providing access to this data to third parties has been implemented for limited use-cases such as Road Safety. The vehicle centric model would become more relevant as more connected and automated vehicles get introduced on the road.

4.3.3 Key Features

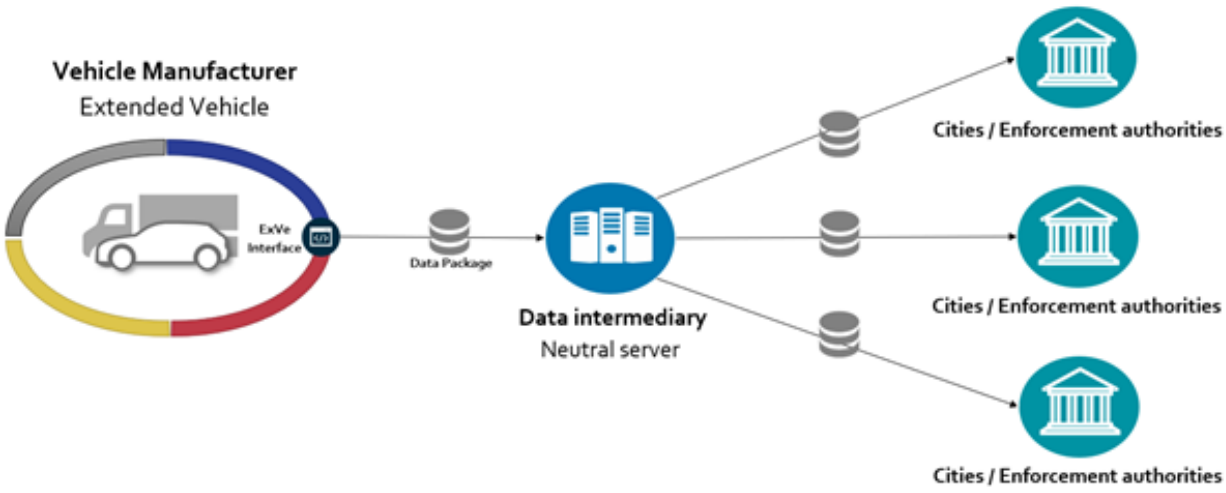
- Under this model, the data generated by the vehicle itself is shared with / made accessible to city infrastructure/authorities, allowing them to check if a UVAR offence has been committed or not.
- This model emerges from the "extended vehicle concept" identified by vehicle manufacturers, where relevant vehicle data could be made available to third parties, including local authorities in a streamlined manner to facilitate a range of different activities.

4.3.4 How it works

- To streamline data sharing and ensure safety and security of a connected vehicle, this model involves creation of a data package (containing data relevant for a specific purpose such as UVAR enforcement) and sharing it with third parties (such as city authorities) via a data intermediary, which is a neutral server.
- The role of the data intermediary is to ensure the authenticity of the data and make it available to authorized end-users in a secure and legally compliant manner for different purposes (such as, UVAR enforcement).

The image below provides a diagrammatic representation of this model:

Figure 3: Data sharing under the vehicle centric model



4.3.5 Opportunities and Challenges

Organisational	
Opportunities	Challenges
The model could facilitate a direct communication between a connected vehicle and city infrastructure,	The possibility to use this model is limited to connected vehicles and could lead to the exclusion of older models.

removing the need for city authorities to consult vehicle registration authority to access technical vehicle data.	The percentage of connected vehicles is currently relatively low and this model does not target the main vehicle groups that are excluded from Low Emission Zones (like old diesel and petrol engine propelled vehicles). The model, however, may be relevant in the future for UVARs such as Zero Emission Zones. The relevance is also dependant on the timescales of the solution, compared to the implementation of the ZEZs and the proportion of zero emission vehicles with this technology.
In an integrated/combined solution model obtaining information on vehicle data by means of cross border data acquisition is no longer necessary. This could also be the case for vehicle owner/holder data.	Verification of the owner/holder data can still be something that has to be verified through (cross border) verification.
Legal	
Opportunities	Challenges
The revision of the current roadworthiness framework could offer an opportunity. Similarly, ISO standards 20077 could provide basis for the technical architecture. Multiparty agreements established for the deployment of SRTI Ecosystem could also be leveraged to establish the necessary legal basis.	Legal basis for sharing data in this model will have to be ascertained.
Technical	
Opportunities	Challenges
Communication layer on 4G and 5G level is available in the C-ITS landscape. Vehicle data could be obtained based on geofencing once the geofencing technology/system for it is developed.	The model may require city authorities to install specific infrastructure to interact with a connected vehicle and/or with the data intermediary.
	This model may be relevant for consulting vehicle technical data to establish compliance with a UVAR. However, it may not be possible to consult vehicle owner/holder data under this model, as vehicle manufacturers may not be willing to share it on account of privacy concerns. In this case, the challenges we encounter today would continue to apply for owner/holder data.
Misc. (Non Essential)	
Opportunities	Challenges
Exemptions could be communicated by the vehicle.	-

4.3.6 Vehicle-centric model variant – special number plates

A distinct, low-tech approach under the vehicle centric model could be to allow city/enforcement authorities to get information about the vehicle directly from the vehicle number plates. This approach emerges from a recent trend observed in several Member States.

Countries like Norway, Germany, Austria, Poland, Latvia, Switzerland and the United Kingdom have started to issue number plates for electric and zero emission vehicles.

This approach could facilitate a direct mechanism for obtaining relevant vehicle data for ZEZs but not for LEZs. This may be particularly relevant given the increase, and the likely further increase, in the number of Zero Emission Zones in them towards the EU aim of carbon neutrality.

For the ideal implementation of this approach for cross-border enforcement, there would need to be a register stating the formats of these number plates, so that they are recognized across the EU. Alternatively, each city/Member State could identify the different formats themselves – once they exist. While harmonisation of the number plates might be ideal, it is more important that they are understood and recognised – each Member State anyway has different number plate formats. However, what is important is that there are number plate options that indicate 100% zero emission vehicles (ZEV). This is currently available for all the above MS with the exception of Germany, where the number plate is combined with plug-in hybrids (PHEV).

There are already systems in place to ensure that number plates cannot be forged or misused to avoid enforcement.

The method would work for both ANPR and manual enforcement. However, a mechanism to obtain vehicle owner/holder data would still be required to issue fines to vehicles found to be non-compliant.

4.4 Internal Market Information System tool (IMI)[18]

IMI is a *technical tool* that can be used for different *data sharing models* discussed above. It has been developed jointly by the Commission and national administrations of Member States. It facilitates exchange of information between public authorities involved in the practical implementation of EU laws. It interconnects authorities at local, regional, and national levels across the EU (EEA), helping administrative bodies to identify their counterparts in other EU Member States and contact them to ask for and share information. In every Member State, the position of a national IMI coordinator (NIMIC) has also been created.

IMI offers several different options for exchanging information:

- “one-to-one” exchanges between two competent authorities.
- “one-to-many” exchanges where Member States can share information with other Member States and/or the Commission.
- “repositories” allow authorities to share information relating to a specific policy area in a centralised database.

[18] https://ec.europa.eu/internal_market/imi-net/index_en.htm

- "Public interfaces" allows external actors to communicate with competent authorities registered in IMI.

Since IMI has already been used by the European Commission in several different domains,[19] it should be considered as a technical tool that could facilitate exchange of information for cross-border enforcement of UVARs.

Given the different possibilities offered by IMI to exchange information, it can be relevant for both the Authority centric model (described in chapter 4.1) as well as Driver Centric model (described in chapter 4.2) on cross border UVAR enforcement.

- Under *Authority Centric* model, IMI could provide a platform to connect cities with national vehicle registration databases, to request vehicle data as well as vehicle owner/holder data.

- Under the *Authority Centric or Driver Centric* model, it could also become a trusted repository of relevant UVAR enforcement related data, that can be directly consulted by city authorities (this could be done on the basis of consent or on the basis of EU wide legal agreement).

- Under *Driver Centric* model, IMI maybe able to provide a platform for drivers to directly share their digital statement/verifiable credentials etc. with different cities.

    - **IMPORTANT:** A similar approach is currently being implemented by DG MOVE and DG DIGIT for the purpose of enforcement the new EU rules on the posting of drivers in the transport sector, where drivers/companies can directly upload their posting declarations on IMI portal. The uploaded posting declarations can be then checked by enforcement authorities to examine the veracity of the declaration and establish commission of an offence related to posting rules. An additional IMI application has also been created to enable road transport companies to input/consult and modify required data about their drivers and operations.

It must be noted, however, that IMI has not been used in the context of UVARs and is essentially focused on implementation of EU wide laws. Therefore a legal basis and technical adaptations maybe required before it can be used to connect and share information in the context of UVARs.

[19] https://ec.europa.eu/internal_market/imi-net/library/index_en.htm#policylegal

5. UVAR cross-border enforcement requirements

Based on the desk research and different consultation meetings with a large number of stakeholders involved in the UVAR cross-border enforcement process, requirements can be set up that a cross-border enforcement solution should adhere to and can be reviewed on. The requirements will also form the basis for the SWOT analysis of different solution models that will be performed during the demonstration phase as well as the final report under this task. This chapter will focus on the main requirements of an UVAR cross-border enforcement solution in order to function for its intended use. A full overview of all the requirements for the system as a whole, that are identified in this study so far, can be found in Appendix A.

General requirements

The solution should be able to work for ANPR enforced UVARs, as well as for manually enforced UVARs. Throughout the EU, for different reasons, Member States differ in the way that UVARs are enforced. If EU-wide enforcement is a goal of this project, then an enforcement solution should work for all methods used by the Member States.

Following the same ideology, the system should accommodate different enforcement entities. Throughout the Member States, different entities are responsible for UVAR enforcement, from local to regional and national authorities as well as private companies on their behalf. The system should allow all these to enforce UVARs cross-border.

The solution should be cost-efficient. This means that the benefits the solution brings to the cross-border enforcement process should be higher than the current performance. It should not bring high costs or burdens on the stakeholders in the enforcement process.

Organisational requirements

If possible, no preregistration should be required for vehicle owners/holders when a vehicle is compliant with the UVAR regulations. This will go with the idea within the EU for the right of free movement throughout the EU Member states.

If registration of the vehicle cannot be avoided for vehicle owner/holder to enter an LEZ, it should be made easy by allowing for the possibility to register only once. The solution should incorporate a single point of contact where administrative issues can be handled. For example, where new vehicles can be registered, but also can be removed when the vehicle owner changes.

For the purpose of identifying a standardised solution, another requirement is that the solution should be able to be implemented EU wide. This streamlines the UVAR cross-border enforcement for all member states.

Legal requirements

The solution should be compliant with data protection and privacy laws. Taking into account GDPR the exchange of technical data and owner/holder data should comply with the latest privacy regulations.

Next to this, it should be possible for the offender to request evidence of the offence. For example, by requesting a photo of the offence registered by an ANPR camera.

Technical requirements

The solution should be able to provide all technical vehicle data that is needed to enforce a UVAR, for example, vehicle age, engine type, emission class or propulsion system. This data needs to be verified by an authority to ensure there cannot be fraudulent vehicle data put on the system by an owner.

The vehicle owner/holder data should be able to be determined by the authority issuing the fine after the identification of non-compliance based on the vehicle's technical data.

The key requirements are summarised in Table 4 and a full list can be found in Appendix A.

Table 4: Summary of requirements

#	Requirements of the system as a whole	
G*	**Needs to work for ANPR and manual schemes**	
Elaboration:		Class: Mandatory
G	**Should accommodate different enforcement entities**	
Elaboration:		Class: Mandatory
G	**Should be cost efficient**	
Elaboration:	Benefits of the solution should be higher than the current performance	Class: Ideally
O	**Vehicle owners should not have to preregister to be able to enter a UVAR**	
Elaboration:		Class: Ideally
O	**If registration of the vehicle is necessary for the vehicle owner/holder, the solution should incorporate mecahnisms that make the process easy e.g., by allowing for the possibility to register once only.**	
Elaboration:	The burden for the owner holder should be kept at a minimum and procedures should be self explaining	Class: Ideally
O	**Should be able to be implemented EU wide**	
Elaboration:		Class: Ideally
L	**Must comply with data protection and privacy laws (and norms)**	
Elaboration:		Class: Mandatory
L	**Confirmation of offence should be able to be requested by vehicle owner/holder**	
Elaboration:	e.g., retrieve photo of offence	Class: Ideally
T	**Should be able to provide all technical vehicle data that is needed to enforce a UVAR**	
Elaboration:		Class: Mandatory
T	**Vehicle owner/holder data should be able to be determined by the fine issuing authority based on the vehicle's technical data when vehicle is non compliant**	
Elaboration:		Class: Mandatory

* Key of letters indicate the type of issue: G= General, O = Organisational, L=Legal, T=Technical.

6. Conclusions and Next Steps

This report provides an overview of the complexities in sharing data relevant for cross-border UVAR enforcement by listing current national and cross-border enforcement practices.

It describes different models that can facilitate international exchange of data relevant for the enforcing UVARs, as well as some of the technical tools that are either being used or can be used for implementing these models. The opportunities and challenges related to each model have also been discussed.

Legal Instruments that can provide a basis for sharing data through different models have also been described along with the challenges in using and applying them in the context of UVARs.

A list of the requirements for an EU wide data sharing solution for UVAR enforcement has been provided. In the next phase of the project (Task 2.3), demonstrations will be organized to show the feasible of the data sharing models/solutions and assess their effectiveness in light of these requirements. On the basis of this, recommendations will be developed to facilitate cross-border data sharing to enforce UVARs.

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- Directive (EU) 2019/520 – on the interoperability of electronic road toll systems and facilitating cross-border exchange of information on the failure to pay road fees in the Union
- Directive 2014/45/EU – on periodic roadworthiness tests for motor vehicles and their trailers
- Directive 2014/46/EU – amending Council Directive 1999/37/EC on the registration documents for vehicles
- Directive 2014/47/EU – on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Union
- Regulation (EU) 2019/631 – setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles.
- Directive 2010/40/EU – on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport
- Regulation (EU) 2018/1724 – establishing a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services.
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- Proposal for a Regulation on harmonised rules on fair access to and use of data – Data Act.
- Council Decision 2008/615/JHA on the stepping up of cross-border cooperation, particularly in combating terrorism and cross-border crime.
- Council Decision 2008/616/JHA on the stepping up of cross-border cooperation, particularly in combating terrorism and cross-border crime.

Websites

- https://www.eucaris.net/
- https://urbanaccessregulations.eu/
- https://civitas-reveal.eu/
- https://uvarbox.eu/
- https://toop.eu/

Appendix A

Appendix A gives the full list of requirements of the system of a whole.

General

#	Requirements of the system as a whole	
G01	**The system as a whole supports cross-border exchange of vehicle and owner data**	
Elaboration:	Ideally a single solution that does both,for ease of use and reduction of expense.	Class: Mandatory
G02	**Should be sustainable and minimise the burden for EU citizens of extra costs and being able to enter UVARs**	
Elaboration:	This includes any costs that would be incurred by the UVAR enforcer itself (paying for entering or being within the UVAR).	Class: Ideally
G03	**Should be cost efficient**	
Elaboration:	Benefits of the solution should be higher than the current performance.	Class: Ideally
G04	**Needs to work for ANPR and manual schemes**	
Elaboration:		Class: Mandatory
G05	**Should accommodate different enforcement entities**	
Elaboration:	e.g., (city authorities, police, others)	Class: Mandatory
G06	**Should work for all types of UVARs**	
Elaboration:	e.g., LEZ, LTZ, Parking	Class: Ideally

Organisational

#	Requirements of the systems as a whole	
O01	**Vehicle owners should ideally not have to preregister to be able to enter a UVAR legally**	
Elaboration:		Class: Ideally
O02	**Should be able to be implemented EU wide**	
Elaboration:		Class: Ideally
O03	**The cross-border exchange process should be simplified**	
Elaboration:	For instance, lower the number of organisations that are involved in the process.	Class: Ideally
O04	**Solution provider should be able to have a direct link to governing authority**	
Elaboration:	This may be up to the national authorities whether they want to enable this or not; but the system itself should enable it (eg access to the EUCARIS contact point). If national authorities do not enable this, they must enable an alternative method of ensuring that no fraudulent data is in the system.	Class: Ideally
O06	**If registration of the vehicle is necessary for the vehicle owner/holder, the solution should incorporate mecahnisms that make the process easy**	
Elaboration:	e.g., by allowing for the possibility to register only once.	Class: Ideally
O07	**Vehicle information should be aligned in EU**	

Elaboration:		Class: Ideally
O08	**Should accommodate (vehicle-type based) exemptions**	
Elaboration:		Class: Ideally

Legal

#	Requirements of the systems as a whole	Classification
L01	**Must comply with data protection and privacy laws (and norms)**	
Elaboration:		Class: Mandatory
L02	**A single solution EU wide**	
Elaboration:	If that is not possible, the possibility to have two legal options and the MS is required to enable one. In this case, the choice of one MS to choose a selected option should not result in (significant) additional work for other MS. Some of the solutions provide technical data, and require another solution for owner/holder data.	Class: Ideally
L03	**Should be able to accommodate national differences in data collection and processing standards and practices**	
Elaboration:		Class: Mandatory
L04	**Confirmation of offence should be able to be requested by vehicle owner/holder**	
Elaboration:	e.g.,, request a photo of the incident, legally required for some countries for ANPR.	Class: Ideally
L05	**Should also work for neighbouring countries (CH, UK, NO) to ensure vehicles from these countries are also enforced**	
Elaboration:		Class: Ideally

Solution

#	Requirements of the systems as a whole	Classification
S01	**The solution must have a level of maturity that an EU-wide rollout is evident possible within 3 (5) years**	
Elaboration:	For demo purposes the solution must able to showcase in April 2022.	Class: Ideally
S02	**The solution should provide an API or other mechanism by which requests can be activated**	
Elaboration:		Class: Ideally
S03	**The solution should provide a response API / mechanism with handshake to ensure delivery of the information**	
Elaboration:		Class: Ideally
S04	**Should be easy to use for authorities**	
Elaboration:		Class: Mandatory
S07	**Should have good cybersecurity for personal data**	
Elaboration:	e.g., include 2FA	Class: Mandatory

	Needs to work for all vehicles, not just new ones	
Elaboration:		Class: Mandatory
	Each solution needs to be able to get the data for vehicles from every Member State	
Elaboration:		Class: Ideally
	A single option for vehicle identification as well as sending fines	
Elaboration:		Class:Ideally
	Should have a roadmap explaining how it can be feasible to be implemented in all Member States	
Elaboration:	For example, highlight ways that countries have ensured that cities accessing the national vehicle databases and/or EUCARIS can do so appropriately. Or if there are two options, how the choice of one solution in one MS affects what needs to be done in other MSs.	Class: Ideally
	Should be accompanied with technical functional documentation supporting the implementation of its components by all needed local national organisations	
Elaboration:		Class: Mandatory
	Is similar to what cities are currently using.	
Elaboration:		Class: Ideally
	The system should give reliable, valid data, and be robust against fraud.	
Elaboration:		Class: Mandatory

Technical

#	Requirements of the systems as a whole	Classification
T01	**Vehicle types should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	passenger car,van, trailer & tractor, trailer lorry, lorry, coach, motorcycle, (taxi), non-road mobile machinery, special vehicle etc.	Class: Mandatory
T02	**Vehicle UNECE category should be made available on request for foreign vehicles base on the Number plate (or registration)**	
Elaboration:	N1, N2, etc.	Class: Mandatory
T03	**Vehicle weight should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	e.g., Gross vehicle weight of the vehicle, or over 3.5T, over 7.5 T, 12T	Class: Mandatory
T04	**Vehicle length should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	e.g., for >12 m	Class: Mandatory
T05	**Vehicle propulsion type should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	Full electric, fuel cell, Hybrid, PHEV (with range), petrol, diesel, 2-stroke, H_2 combustion, gas (LPG/CNG/LNG).	Class: Mandatory
T06	**Vehicle Euro norm and propulsion should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	For countries / vehicles that do not have Euro norm on the database, date of first registration should be available as a proxy. LEZ rules should state that this is possible where Euro standard is not available.	Class: Mandatory
T07	**Vehicle retrofit should be made available on request for foreign vehicles based on the number plate (or registration)**	
Elaboration:	Retrofitting, eg diesel particulate filter, or a replacement/converted engine. This is not always on vehicle databases, and where it is not available exemptions are used. Retrofitting is becoming less relevant for on-road vehicles.	Class: Ideally
T08	**Vehicle owner data should be made available based on the number plate (or registration) on request for foreign vehicles that do not comply to regulations**	
Elaboration:	Name, surname, address, postal code, country	Class: Mandatory
T09	**Interfaces need to be standardized**	
Elaboration:	e.g., xml, json etc.	Class: Ideally
T10	**The vehicle information should be in a standardised form, so that it can be exchanged between countries.**	
Elaboration:	Throughout Europe?	Class: Ideally
T11	**Query multiple countries in one batch if needed**	
Elaboration:		Class: Ideally
T15	**Technical interfaces must be based on documented open standards**	
Elaboration:	Data models, communication protocols	Class: Ideally
T16	**Ideally give vehicle holder, where this varies from the owner and is available**	
Elaboration:		Class: Ideally

Non functional

Performance requirements

#	Requirements of the systems as a whole	Classification
P01	**The solution must be scalable for retrieving 1 million foreign vehicle technical information requests per day over the whole of Europe**	
Elaboration:	1000 UVARs 3% foreign vehicles of on average 100.000 registrations per day (best guess)	Class: Mandatory
P02	**The solution must be scalable for retrieving 50.000-100.000 on foreign owner information requests per day for LEZs**	
Elaboration:	Best guess	Class: Mandatory
P03	**Response time should be within 72 hours amount of time**	
Elaboration:	Exact definition TBD	Class: Ideally
P04	**Include performance indicators/ reporting.**	
Elaboration:	How many detected/queried vehicles are successfully identified; how many owners are identified; accuracy, punctuality, effectiveness.	Class: Ideally

Quality requirements

#	Requirements of the systems as a whole	Classification
Q01	**The solution should be available for 95% of the time with a maximum downtime of 1 day once per quarter**	
Elaboration:		Class: Mandatory
Q03	**Vehicle information obtained must be up to date and correct, and protected from fraud**	
Elaboration:		Class: Mandatory
Q04	**Vehicle data needs to be validated by national authority to prevent / reduce fraudulent entries**	
Elaboration:		Class: Mandatory