VOXPOP

Lisbon Mobility
Goes Digital

EUROPEAN UNION
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UIA URBAN INNOVATIVE ACTIONS

A4.4 URBAN ACCESS POINT

D4.4.1 – Market Research

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Introduction

The following document is a key deliverable for WP4 – Data Sharing Business Models. The purpose of this report is to present market research, providing organized information about the trends on data platforms across Europe. This information can be very useful, for instance, for public decision-makers, innovation communities, and mobility operators.

The VoxPop project (in particular under the scope of Activity 4.4) aims at creating an Urban Access Point (UAP) to interconnect the various existing management systems. Following a "System of Systems" approach, the UAP will be a non-discriminatory facilitator between the different marketplace participants, while providing the trustworthiness of an impartial data gatekeeper. The creation of this tool will unlock the value of data through the integration of demand data, asset information, and service supply data, with a collaborative data-sharing model across stakeholders.

WP4 entails all activities leading to the development of the UAP, following a balanced and sustainable multi-party governance operating framework, that will provide an overarching model for how mobility-related data is shared and exploited between public and private entities in Lisbon. These organizations will work together in the co-design of the enhanced digital innovation space in Lisbon, sharing the responsibility for the creation of a trusted data environment.

The design and development of the UAP, which is the core of the VoxPop Project, is only possible and successful when privileging extensive work provided by all entities involved in the Project, especially in WP4. At that framework, Activity 4.4 has a strong connection with the other activities, which feed the UAP design and definitions. First, a landscape analysis, reviewing current

governance and business models for public/private data-sharing is crucial to further define how data will be shared (Activity 4.1). Second, to deploy the UAP, it is mandatory to have an organized team, coordinating and managing the members and their relevant actors (Activity 4.2). Finally, the assessment of the state of play will be followed by the development of a business model design process, leading to the creation of Data Sharing Protocols (DSP) setting out the principles and rules binding the organizations involved in the data-sharing ecosystem (Activity 4.3). Thus, the present delivery complements the overall tasks by providing desk research on a set of case studies to understand needs in other EU cities, current standards, and trends in urban platforms. The goal is to keep up with the already existing data platforms and be aware of the latest developments, keeping the information up-to-date. It is worth mentioning that this deliverable only focuses on the Market Research that will guide the User Needs & System Requirements, which will be better explored (also resulting in a deliverable) on a posterior phase of the Project.

Furthermore, the project will set up an Innovators Alliance to enable the dialogue with the wider group of stakeholders of public and private mobility solution providers. This group will be involved in the co-design of the public-private data-sharing business model of Lisbon, helping to identify value propositions that explore different levels of data sharing and routes to implementation, such as voluntary data sharing, or exploring the rights established by Art. 20 of the GDPR concerning the right to data portability.

To that effect, Deliverable 4.4.1. presents:

- The “Urban Access Point” on the European scope
- Platforms similar to an “Urban Access Point” implemented on a European level
- Overview on Business Models related to “Data Access Points” and System Architecture
- Urban Access Points relevant regulations and standards

The methodology adopted to achieve the present deliverable’s content was based on secondary research or desk research. In that framework, research was made through existent information, instead of collecting data. All information was accessed through reliable sources such as websites of European initiatives.

The "Urban Access Point" on the European scope

In the last ten years, efforts have been made by the European Commission and the European Parliament to create EU policies at a local level. In this framework, stakeholders from across all Member States established the need for an EU Urban Agenda expecting to strengthen the urban dimension of EU policies and, as a result, improve the quality of life in urban areas.

The Urban Innovative Actions (UIA)[1], where the VoxPop[2] project is included, aims to contribute to the Urban Agenda[3] by allowing and helping urban authorities on testing novel ideas to create economic, social, and territorial cohesion.

Respecting the principles of subsidiarity and proportionality, the Urban Agenda is centered on three fundamental aspects: better regulation, better funding, and better knowledge. Additionally, 12 topics were defined to represent common challenges cities are facing:

- Air quality
- Innovation and responsible public procurement
- Circular economy
- Integration of migrants and refugees
- Climate adaptation
- Jobs and skills in the local economy
- Digital transition
- Housing
- Energy Transition
- Sustainable use of land
- Urban mobility
- Urban Poverty

Focusing on urban mobility, the Urban Agenda agrees that it is crucial to improve the knowledge on the collection and sharing of comparable and reliable information on urban

[1] Urban Innovative Actions, UIA in the European context, information found in https://uia-initiative.eu/en/initiative/uia-european-context, consulted in December 2020

[2] Urban Innovative Actions, VoxPop - People, Processes & Technology towards the digital transformation of the urban mobility system of Lisbon, information found in https://uia-initiative.eu/en/uia-cities/lisbon, consulted in December 2020

[3] European Commission, The Urban Agenda for the EU, information found in https://ec.europa.eu/regional_policy/en/policy/themes/urban-development/agenda/, consulted in December 2020

development topics. In this sense, the European Commission has developed the Urban Data Platform (UDP)[4] which aims at providing access to information on the status and trends of cities and regions and EU-supported urban and territorial development strategies. This platform presents an interactive digital interface, available for any user that wants to explore, download, and analyze data. The information provided by the platform has innumerous sources, among them, the JRC, DG-REGIO, and EUROSTAT, and covers raw data regarding demography, urban development, economic development, transport and accessibility, environment and climate, resource efficiency, and social issues.

At the moment, the UDP offers information on 807 Cities, 672 Functional Urban Area and 271 Metro Regions. A recent study conducted by the Erasmus Centre for Data Analytics analyzed information across cities participating in the UDP and its stage of development was summarized in Figure 1[5].

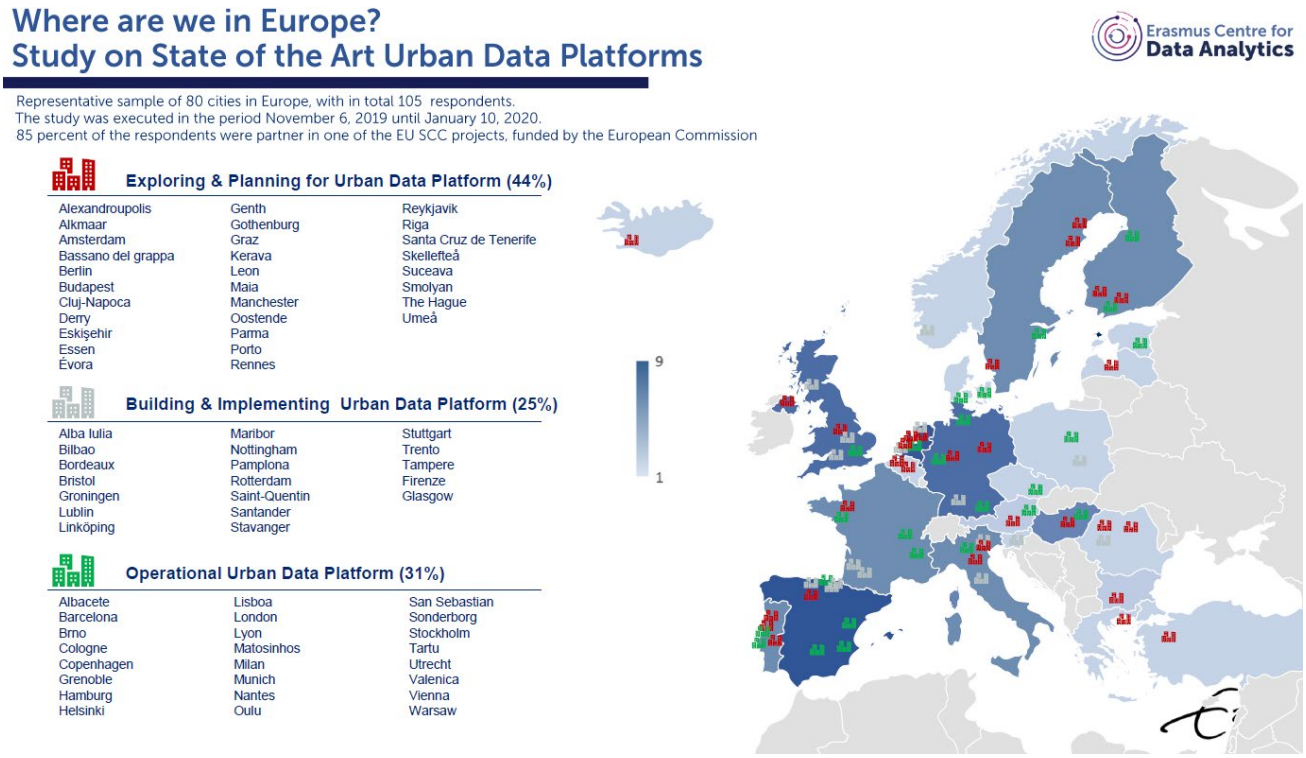

Figure 1 - Participating cities in the study and their stage of development on urban data platforms

In line with the Urban Data Platform, the Urban Access Point (UAP) makes data at an urban level available for users to consult, and/or download. However, some principles are distinct in both systems. The UAP focuses on creating a public and private data-sharing ecosystem, providing detailed and updated information through the integration of demand data, asset information, and service supply data. Moreover, distinct platforms target distinct end-users. Regarding the UAP, the aim is not to make information available to the general public, but

[4] European Commission, Urban Data Platform Plus, information found in https://urban.jrc.ec.europa.eu/#/en, consulted in December 2020

[5] Brandt, T. et al. (2020), Digitally managed cities of the future – how close are we?, information found in https://discovery.rsm.nl/articles/436-digitally-managed-cities-of-the-future-how-close-are-we/, consulted in December 2020

instead, to have a closed ecosystem where specific entities can create value from the available information. Finally, regarding the system's architecture, the UAP is planned to work as a "System of Systems" by collecting and making a bridge to data from multiple sources and formats. Notwithstanding, most information is expected to be homogenized in one single format, respecting defined standards. Thus, the UAP represents a more detailed and homogenous platform that will, for instance, be able to feed the National Access Point (NAP) or other entities, such as the UDP.

Platforms similar to an "Urban Access Point" on a European level

To make cities more sustainable and to promote the well-being of all citizens, several countries have already embraced the benefits of collecting and sharing mobility data. Thus, some cities have/are already developing platforms where this kind of data is fed into, processed and shared among the general public. Research showed that these platforms mainly focus on the following functions[6]:

- Support better urban design, safety, and planning requirements
- Real-time traffic management & even public transport dispatch based on traffic flow
- Innovative mobility service offerings that address market gaps
- Improve safety through improved enforcement (red lights, speeding, etc.)
- Faster provision of emergency services

Moreover, some cities are investing in the development of smart mobility systems at an urban level, essentially by creating and improving smartphone applications. As an example, Vienna created the WienMobil App, which displays all the available options for traveling using public transport, bike, car-sharing, taxi, on foot, or using a combination of these forms of mobility. Within the same lines, Helsinki created the Whim, a mobility app focusing on Mobility as a Service (MaaS) that lets people access both public and private modes of transport (including trains, buses, taxis, bike share, and rental cars) on a single platform, for a set monthly price.

In the next sub-sections, some of the European frontrunners on developing smart and shared mobility are shown. At the end of each subsection, a Table is presented in order to organize the extracted information.

[6] MaRS Solutions Lab, Sharing Mobility Data, information found in https://marsdd.gitbook.io/datatrust/use-cases/sharing-mobility-data, consulted in December 2020

Platforms' detailed information

Netherlands: the Amsterdam data portal and a common portal with several cities

The Data en informatie[7] is a data portal that allows anyone who is looking for reliable and up-to-date information about the city of Amsterdam to consult and download data. The platform presents topical data, statistics and research, and provides quick and new ways to access visual and interactive presentations of data and information. With more than 300 datasets and thousands of publications and articles, at the mobility and transports level, the repository provides information for instance related to traffic, public transports, cycling, environmental zones, or parking.

Moreover, the Netherlands has been developing a national data transfer point, working at an urban level, which will be fully operational from 1 January 2021. The platform, developed by the Monotch company, was named Urban Data Access Platform (UDAP)[8] and will allow a fast and consistent crossing of information between intelligent traffic control systems (ITCSs) and road users. Furthermore, by exchanging data via UDAP, progress in the ITCSs is expected: the information flow between both ITCSs and road users allows to manage the prioritization and optimization of traffic. Besides the fast data exchanging, the UDAP guarantees the four additional functions:

- Quality control (with access control for entities to connect with the UDAP)
- Quality monitoring (standards for data exchange and agreed quality specifications)
- Other objects (allows to connect with other objects besides the ITCSs, for instance, retractable posts in the road, intelligent tire pressure meters, and intelligent height detection meters)
- Priority Broker Configurator (allows a road authority to define the prioritization on intersections with intelligent traffic lights)

From a practical point of view, the UDAP will provide the following information:

- Advice on route and speed
- Individual real-time warnings concerning potentially dangerous situations and road works
- Priority for specific types of vehicles through traffic lights (emergency services, regular buses, cyclists, heavy goods vehicles)
- Real-time traffic light information (initially at 20% of all traffic control facilities in the Netherlands)
- Further improvement of traffic flow through traffic lights
- Information about parking options in the area

[7] Data en informatie platform website: https://data.amsterdam.nl/

[8] Talking Traffic, UDAP as successor of TLEX as national data transfer point, information found in https://www.talking-traffic.com/nl/urban-data-access-platform, consulted in December 2020

Table 1 - Platforms in the Netherlands

Platform/Project denomination	Data en informatie	Urban Data Access Platform (UDAP)
Types of data provided	Mobility-related data: traffic, parking, public transports, bikes, environmental zones, road works, emissions, and accidents. Other areas: work and social security, sustainability and the environment, culture, population, economy, tourism, public order, safety, living, education and science, space and topography, care and welfare.	Mobility-related data: Advice on route and speed; Warnings on potentially dangerous situations and road works; Priority for specific types of vehicles through traffic lights; Traffic light information; Information about parking options in the area.
Data origin	Data is provided by public and private entities (from municipal departments and external partners). The Research, Information and Statistics Department (OIS) collects data about Amsterdam and processes it into information.	Road equipment (such as traffic lights, among others); Anonymized travel and vehicle-related data from road users.
How is the data provided to users?	Data can be accessed through interactive interfaces (treated data) or downloaded in distinct formats (raw data) - e.g. JSON, HTML, XLS, CSV). Also, the platform redirects some information to other websites. The website also presents articles and publications such as fact sheets and research reports.	Data is treated. Monotch is responsible for overseeing the quality, security, and privacy of the data exchange. The platform uses the TLEX I2V software which offers additional interfaces that can be adapted to various message types and have standard-compliant messages such as AMQP1.0 (in compliance with upcoming C-Roads standards), DATEXII, or new types of ETSI messages.
How is the data updated (frequency)?	Depending on the dataset, the platform provides real-time data (e.g. traffic being updated every 5 minutes) or dynamic data, being updated according to the entry of new information on data suppliers.	Very fast (in milliseconds) and reliable exchange of intelligent traffic control systems data and vehicle displacement data.
Who can get access to the data?	The owner of the dataset determines who is allowed to view or use which data. This can apply to the whole dataset or parts of the dataset.	Road authorities; Road users (real-time in-car information services); Parking providers; Traffic Technology Vendors.

Quality Control Mechanism	The source holder is primarily responsible for the quality of the data. Users can contribute to the quality of the data by submitting 'feedback'.	Quality control: If an organization, public authority, or company wants to connect a product to UDAP, the first step in the process is an automatic check of whether the organization and product meet the relevant connection requirements. Quality monitoring: UDAP continuously and automatically identifies exactly what data is exchanged between what parties and checks the quality of this data. For this purpose, UDAP applies the national standards for data exchange and agreed quality specifications.
Operational state	Already operating.	Already operating (launched in January 2021).

Denmark: common portal with several cities, City Data Exchange, and "Copenhagen Connecting"

Concerning their smart city strategy, Denmark considers as a priority to publish accessible and open data. To do that, it created the "Open Data DK" portal[9], which comprises hundreds of datasets bringing together private and public data from several cities across the country. When searching transport-related data, the portal offers more than 200 datasets with information related, for instance, to public transports, city bikes, or traffic. This information, which can be consulted and downloaded for free, allows creating better solutions and new business opportunities for companies.

Aligned with the previous example, the capital created its own portal where data was shared to improve transparency, innovation, and efficiency. The "City Data Exchange" (CDE) aimed at purchasing, selling, and sharing data to citizens, public institutions, and private companies. This private/public partnership results from a collaboration between the Municipality of Copenhagen, the Capital Region of Denmark, and Hitachi.

The document "City Data Exchange - Lessons learned from a private/public data collaboration"[10] explores the experiences from the project and covers the following areas:

- **The Demand For Data:** generally, it is very specific and closely related to a specific product, or use case. To be successful, it is essential to work directly with data providers and those who request data to identify the best solution.

[9] Open Data DK platform website: https://www.opendata.dk/

[10] Municipality of Copenhagen and Capital Region of Denmark (2018), City Data Exchange – Lessons Learned from a Public/Private Data Collaboration, information found in https://cphsolutionslab.dk/media/pages/projekter/data-platforms/city-data-exchange/1837671186-1612174620/city-data-exchange-cde-lessons-learned-from-a-public-private-data-collaboration.pdf, consulted in March 2021

- **Barriers to Effective Data Exchange:** they are mainly related to the immaturity of the market, the lack of use cases to serve as examples, the limited and fragmented data sources, the reluctance to share data on an open data portal, and the lacking skills for people to work with different types of data.
- **Future Trends For Data Exchanges:** it was expected to see the rise of data communities and collaboratives, the introduction of data broker functionalities, and the creation of more tools for easy data search and data handling.
- **Creating An Effective Data Infrastructure:**
    a. Establish solid use cases.
    b. Create a regional and/or national data community.
    c. Establish common standards for data sharing.

From another perspective, Copenhagen developed a project named "Copenhagen Connecting"[11] that has been recently recognized by the Smart Cities Award and aims to create a complete digital infrastructure by combining a city grid (fiber and wireless) with the public data portal, data.kk.dk. The project led by the Copenhagen Solutions Lab, collects anonymous and real-time data and then analyzes it and recognizes issues to improve the knowledge on how the city operates. The collected information has many sources such as Wi-Fi access points mounted in streetlights, Wi-Fi-using devices in cell phones, wearables, bikes, buses, and cars. Moreover, the digital infrastructure connects parking systems, traffic lights, municipal buildings, smart metering systems, and charging stations for electronic vehicles. Thus, this multiple information allows to monitor the pedestrians, bicycles, and other vehicles transitioning around the city and better understand their needs. In this sense, this information's crossing strengthens the intelligent traffic-management systems and, consequently, many benefits arise:

- Traffic-flow optimization and limit congestion
- Reduced pollution (by minimizing CO2 emissions, for instance, related to red light stops)
- Safer traffic environment with a lower number of accidents and incidents
- Multiple advantages for road users (e.g., access to information that allows better trip planning, saving money and time)

It is worth mentioning that at the date of July 2020, the platform was in beta form and the official first version is still being developed.

Table 2 - Platforms in Denmark

Platform/Project denomination	Open Data DK	City Data Exchange*	Copenhagen Connecting
Types of data provided	Mobility-related data: information related to city lightning, bikes, parking, public transports, road	Mobility-related data: the carbon footprint of a travel Other areas:	Mobility-related data: real-time information on parking systems, traffic lights, municipal buildings, smart

[11] Bergman, A. (Fagerhult Innovator), Copenhagen Connected, information found in https://www.fagerhult.com/innovator/copenhagen-connected/, consulted in December 2020

	status, traffic statistics or real-time data, electric car charging stations, noise, weather, etc. Other areas: population and society, justice and public safety, and international issues.	telecommunications, financial, energy, water usage, events, social media, citizens.	metering systems, and charging stations for electronic vehicles. "knowledge about people, movement, cars, bikes, etc. in real-time as well as accumulated over time from the entire city". Other areas: health, energy and climate, smart citizens, smart learning.
Data origin	Municipalities who agreed on a free basic membership. Municipalities are not obligated to acquire new data, they simply need to upload data as they have it - in the original formats.	Private/public datasets and sensor data.	Public data sources from Wi-Fi access points mounted in streetlights to track the movement of Wi-Fi-using devices in cell phones, wearables, bikes, buses, and cars. Also, international companies are strongly encouraged to become business partners, by making investment opportunities and testing new products and technologies.
How is the data provided to users?	Raw data is provided in more than 30 distinct formats (e.g., CSV, JSON, PDF, HTML, etc.) and the portal allows to consult/download the data or redirects the users to the service provider, depending on the municipality's licenses and protocols.	Raw data in distinct formats and analytical tools.	The municipality places data at the disposal of innovative and specialized forces on the market through open standards and licenses and also continues to facilitate and support the utilization of this data in optimal ways.
How is the data updated (frequency)?	Depending on the dataset, the platform provides real-time data (e.g. traffic being updated every 5 minutes in the Aarhus city) or dynamic data, being updated according to the entry of new information on data suppliers. This dynamic data is usually updated every 24 hours.	Information not available.	Real-time data exchange.

Who can get access to the data?	The data is open to the public for free.	Some information is shared for free while other is sold. The targeted data consumers are city departments, public authorities, retailers, property developers/managers, transportation and parking providers, insurance companies, application developers, and consulting firms.	The municipality's data is made available and accessible to the public. However, some data is too sensitive and cannot be provided for free.
Quality Control Mechanism	Information not available.	Hitachi has provided guidelines for a data format that is safe, secure, ensures privacy and makes them easy to use.	Information not available.
Operational state	Already operating (launched in July 2015).	Already operating (launched in May 2016).	Already operating (since around 2014).

*Due to technical complications in accessing the platform, not all information could be properly extracted.

Spain: the cities of Barcelona and Madrid Region

The city of Barcelona is also a smart city frontrunner. Accordingly, the Barcelona City Council, taking advantage of a partnership of the Municipal Institute of Informatics (IMI), created a platform named Sentilo[12]. The Sentilo platform collects data from more than 1800 sensors spread in the city of Barcelona and registers more than 1.300.000 records per day. Moreover, Sentilo works with around 50 private/public partners who support the project, either as users or as providers of services or parts. The collected information allows for improvement technologies such as smart lighting and contributes to water conservation, sustainable energy, and traffic flow optimization. Furthermore, this platform works as an open-source, enabling other cities to analyze its data and learn from them. Finally, the initiative lists to have the following benefits:

- Escape from ITC vertical solutions organized in silos
- Reduce dependency on specific technologies, solutions, or suppliers.
- Avoid isolated compartments where the applications cannot access data from other applications
- Minimize duplicity and multiplicity of data and infrastructures
- Lower investments and maintenance costs

[12] Sentilo platform website: https://www.sentilo.io/wordpress/

In Spain, not only Barcelona but also Madrid has been putting efforts into creating a smarter and more sustainable city as possible. The Consorcio Regional de Transportes de Madrid (CRTM) developed a multimodal mobility portal[13] that comprises real-time information on public transport and shared mobility options from over 30 public and private operators. This platform was created with the main goal of developing Mobility as a Service (MaaS) with high-quality and quantity of information given to users. Moreover, making the city more sustainable was a priority. Public bicycles, parking, car sharing, pollution, alternative modes, and the main road network are examples of topics covered by this platform. Thus, the information and data exchange allows to:

- Providing multimodal information
- Designing mobility services
- Prioritizing the more sustainable travel option

Table 3 - Platforms in Spain

Platform/Project denomination	Sentilo	Multimodal mobility portal
Types of data provided	Mobility-related data: real-time information on bicycle flow, the flow of people, occupancy of parking space, or traffic. Other areas: energy, noise, urban lab, garbage collection, air quality, temperature.	Mobility-related data: real-time information on public transport and shared mobility (e.g. information related to all public transport modes, taxis and related services, bicycles, shared vehicles, or charging stations for electronic vehicles).
Data origin	Direct data providers: devices, hubs, third party apps W/Protocol adapter: Scada, Smart Metering, third party systems.	Over 30 public and private transport operators.
How is the data provided to users?	The platform receives raw data (which is published on a repository) and uses an API REST interface to make it easy to connect sensors and applications.	The platform provides an open data format, allowing developers to create and design their mobility services applications. Raw data can be downloaded in distinct formats (GTFS, SHP, KML, CSV, GeoServicio, and GeoJSON). Also, the platform redirects some information to other websites.
How is the data updated (frequency)?	Real-time data exchange.	Real-time data exchange.
Who can get access to the data?	Sentilo is an open-source platform and has no licensing costs (license LPGL3 and EUPL 1.1). Sentilo is not aimed at end-users: they are the ultimate beneficiaries of the services provided system,	The platform is dedicated to groups interested in providing travel information and mobility services to citizens across the region, such as app developers and public authorities. Access to the platform is free. However, the use of certain services

[13] Multimodal mobility portal platform website: https://datos-movilidad.crtm.es/

	but they are not going to install the product in their workstations. The platform is directed to municipalities and organizations.	requires the completion of a corresponding form.
Quality Control Mechanism	Any request received must be validated by the system following the terminology AAA (Authentication, Authorization, Accounting).	A permanent monitoring of supply and demand is carried out, guaranteeing the quality of the service and the best attention to citizens
Operational state	Already operating (project started in November 2012).	Already operating (project's demonstration phase from September 2018 to August 2019).

United Kingdom: London Region

London was a pioneer city concerning data sharing and smart mobility and the London Datastore repository[14] celebrated 10 years in January 2020. The London Datastore has been created by the Greater London Authority (GLA) with aim of making free and available the data that the GLA and other public sector organizations hold about the city of London. The original repository grew from 500 to the 6000 datasets that are currently available. Additionally, in 2018, a huge step was taken and the data was expanded to the private sector, and data from sensors were added. Besides, at the first stage, the initiative tended to target data analysts, several applications have been developed to allow non-professional to access and interpret the available information. In this sense, in the last few years, there was an increasing dedication to making the data store more user-friendly. In parallel, the Unified API was developed by Transport for London (TfL), which opened several datasets for buses and trams. This step was crucial since it allowed the creation of new apps and to feed the already available ones, such as Google Maps and Citymapper.

The London Datastore englobes several topics besides transports, such as demographics, health, sport, education, art, business, and economy. Concerning transports and mobility, the principal information bases on:

- Lost Customer Hours (Tube)
- Number of Journeys on the Network (bus journeys, underground journeys, and all other journeys)
- Journey Time Reliability (%)
- Cycle Flows on the TFL Road Network
- Number of Bicycle Hires
- Killed or Seriously Injured (KSI)
- KSI by Road User Type
- Serious and Severe Disruption on the Roads (planned or unplanned)

[14] London Datastore repository platform website: https://data.london.gov.uk/

Table 4 - Platforms in the UK

Platform/Project denomination	London Datastore repository
Types of data provided	Mobility-related data: lost customer hours (tube); the number of journeys on the network (bus journeys, underground journeys, and all other journeys); journey time reliability; cycle flows on the road network; the number of bicycle hires; killed or seriously injured (KSI); KSI by road user type; serious and severe disruption on the roads; low emission zones, among others. Other areas: jobs and economy, environment, community safety, housing, communities, health, London as a world city.
Data origin	Public authorities, private sector, and sensors.
How is the data provided to users?	Raw data can be extracted in the following formats: spreadsheet, CSV File, Website, PDF File, ZIP File, GeoPackage, API Endpoint, Image, or XML File.
How is the data updated (frequency)?	Data is being constantly updated. The information of the last version update is indicated on the website (it can be days or minutes).
Who can get access to the data?	The data is open to the public for free.
Quality Control Mechanism	Transport for London has several data checking procedures in place to ensure that the statistics they produce are of the highest possible quality and integrity. The quality assurance framework is supported by a document named Information Management Standards.
Operational state	Already operating (launched in 2010).

Finland: Helsinki region

Helsinki has a platform available named "Region Infoshare"[15] that aims at making regional information easily accessible to all. The platform provides information not only from the urban center of Helsinki but to the neighboring cities Espoo, Vantaa, and Kauniainen. The data covers topics such as transport, housing, the constructed environment, maps, economy, and population, among others, and can be accessed by citizens, businesses, universities, academies, research facilities, or municipal administration. Concerning mobility-related data, the following topics are explored on the platform:

Public transportation

- Schedules, routes (real-time information)
- Parking
- Parking payment zones
- Residential and corporate parking zones in Helsinki
- Tourist traffic stops and parking places in Helsinki

[15] Region Infoshare platform website: www.hri.fi

- Real-time parking usage data (from parking ticket machines and mobile payment operators)
- Parking violations issued

Safety

- Pedestrian slip warnings
- Statistics on traffic accidents

Emissions

- Traffic and industry noise zones

Urban environment

- 3D city model, 3D buildings, and lidar datasets of the city
- Road map (roads, sidewalks, pedestrian crossings, paths, etc.)
- Crossings with traffic lights
- Prioritized winter maintenance network for pedestrians and cyclists

Activities

- Nature trails and nature information (e.g. conservation areas)

Traffic volume

- Statistics on e.g. traffic volumes, number of cyclists

Table 5 - Platforms in Finland

Platform/Project denomination	Region Infoshare
Types of data provided	Mobility-related data: public transports (e.g. schedules, routes, parking); safety (pedestrian slip warnings and statistics on traffic accidents); emissions; urban environment (2D and 3D maps); activities and traffic volume. Other areas: housing, local government, culture and recreation, education, the constructed environment, economy and taxation, health and social services, jobs and industries, populations, environments, and nature.
Data origin	Data is provided by 90 distinct public-sector organizations as well as posts and comments generated by users of the Service.
How is the data provided to users?	Only public data is available. Raw data is provided in more than 30 distinct formats (most on PXWEB, PC-AXIS, and XLS). The website also has available reports and articles.
How is the data updated (frequency)?	Data is static, including datasets from several years (e.g. an orthophotograph from 1954). The newest document found in this research was updated 5 days ago (update data is indicated on the website).
Who can get access to the data?	The data is open to the public for free.

Quality Control Mechanism	The Service Providers are not liable for the accuracy of the information on the Service. Users of the Service use the datasets on the Service at their own risk. The Service Providers are not liable for any direct or indirect loss or damage resulting from the use of the datasets or for any loss or damage resulting from interruptions in the availability of the Service.
Operational state	Already operating (launched in March 2011).

Germany: the city of Berlin

Over the last years, the business division of Digital Public Services (DPS), of the Fraunhofer FOKUS, has been putting efforts into designing and implementing open data portals. Thus, Fraunhofer's resources and expertise have been applied at the "Real Time Data Hub" project with the main goal of "the conception and prototypical development of a real-time data platform in combination with exemplary and distributed sensors"[16]. On this platform, real-time data is collected by sensors spread across the city, processed and made accessible for both people and machines so that it can be used by public or private corporations to help to develop their services and business models. It is worth mentioning that it is an ongoing project aiming of expanding and upgrade existing open data infrastructures by providing real-time sensor information.

Table 6 - Platforms in Germany

Platform/Project denomination	Real Time Data Hub
Types of data provided	Mobility-related data: traffic. Other areas: environment.
Data origin	Real-time data collected by sensors distributed among the city.
How is the data provided to users?	Data is aggregated, processed and made available to both people and machines. The objective is to apply established and existing open data technologies like CKAN and Open MTC.
How is the data updated (frequency)?	Real-time data exchange.
Who can get access to the data?	The data is open to the public for free. However, the main purpose is to be accessed by app developers.
Quality Control Mechanism	Information not available.
Operational state	Ongoing project, only a prototype is now available.

[16] Fraunhofer Society, Real time data hub, information found in https://www.digitale-vernetzung.org/de/projekte/datahub.html, consulted in December 2020

France: the Paris Region and the Vianova mobility data platform

With the main purpose of improving the cooperation between cities and shared mobility operators, as well as promoting better use of public space, the Vianova mobility data platform[17] has raised €1.8M funded by the Capital Innovation and Contrarian Ventures (RATP). The initiative claims that assure more sustainable and accessible modes of transport is a priority, but also, the platform will help cities making better data-driven decisions related to transports and urban planning. At this time, the Paris-based platform covers over 2 million trips per month, working with the following city partners: Brussels, Helsinki, Zurich, and Stockholm.

Finally, Thibault Castagne, co-founder & CEO of Vianova, reinforce the necessity of having quality and well-timed data to empower cities to:

- Manage enforcement of transport regulations in real-time;
- Identify and enable timely intervention in incidents on the transport networks;
- Provide advice back to travelers on the real-time status of the network and nudging their transport choices;
- Measure the effectiveness of the current transport system's operations and for developing long term transport models and forecasts;
- Enable penalties or other charges to be allocated to operators as agreed within the city.

Table 7 - Platforms in France

Platform/Project denomination	Vianova Mobility Data Platform
Types of data provided	Mobility-related data: real-time vehicle locations; hazard alerts; mobility patterns (origin/destination matrix); parking; policies and compliance; curbside management.
Data origin	Mobility operators (vehicle identifiers).
How is the data provided to users?	Data is supplied to the platform in a standard format (MDS or GBFS). GBFS is used for bike-sharing data while the overall data follows the MDS (Mobility Data Specification). The MDS is based on two Application Programming Interfaces (APIs): Agency API for real-time data and Provider API for historical data.
How is the data updated (frequency)?	Real-time data exchange and historical data.
Who can get access to the data?	Insights and data are for the exclusive use of the municipality purposes. License fees of operators to partly finance infrastructure and data lake.

[17] Silicon canals editorial team (2020), This French mobility data platform raises €1.8M to improve collaboration between cities & shared mobility operators, information found in https://siliconcanals.com/news/startups/travel-mobility/mobility-data-platform-raises-1-8m/, consulted in December 2020

Quality Control Mechanism	The platform includes a management system to control, regulate, plan and monitor GDPR compliance, data quality, and policy management.
Operational state	Already operating (company founded in 2018).

Norway: Stockholm Region

To promote innovation and transparency, the City of Stockholm is developing an Open Data Portal[18] with public information, available to the public. Stockholm provides one-third of all open data from the Swedish public sector and the portal provides more than 100 datasets. The initiative is now comprising 26 municipalities that are sharing their data freely, but it aims to ensure a national scale, comprising 290 municipalities and the country's business community. The city believes that open data will be a great contribution to small and medium-sized enterprises to grow and innovate.

The platform provides information about distinct areas, among them, the economy, environment, health, society and culture, and transport. Transport-related datasets explore information such as lighting installation, environmentally friendly cars, city bikes, parking areas, street work, vehicle limitations (length, width, or weight), signaling, traffic, and road characteristics.

Table 8 - Platforms in Norway

Platform/Project denomination	Oppna data Dataportalen
Types of data provided	Mobility-related data: Lightning installation, environmentally friendly cars, city bikes, parking areas, street work, vehicle limitations (length, width, or weight), signalization, traffic, and road characteristics. Other areas: buildings and structures, administrative boundaries, economy, health, society, culture, and environment.
Data origin	Public data from municipalities.
How is the data provided to users?	The platform provides data mostly in HTML format. Some information is also provided through WFS and WMS services. Moreover, the platform redirects some information to other websites.
How is the data updated (frequency)?	Data is static, including datasets from several years. The newest document found in this research was updated the day before (update data is indicated on the website).
Who can get access to the data?	The data is open to the public for free.
Quality Control Mechanism	Information not available.
Operational state	Already operating (since around 2011).

[18] Oppna data Dataportalen platform website: https://dataportalen.stockholm.se/dataportalen/

Belgium: Flanders Region

The Flanders Region has available their open data platform, the Open data in Vlaanderen[19], which is the portal for all open data of governments in Flanders, downloadable through different international standards. Within the transport and mobility scope, the platform provides information for instance related to road accidents and deaths; bicycle rental; green areas; shared mobility; energy consumption and emissions; public transports, or traffic. To ease the data exchange between distinct open data platforms and to ensure among data portals across Europe, Flanders follows the DCAT-AP - Application Profile for data portals in Europe – which consists of a specification based on the Data Catalog Vocabulary (DCAT). Furthermore, intending to guide local authorities in creating their open data ecosystems, the Smart Flanders project created the Charter on Open Data[20]. In this document, 20 principles (e.g., open-by default and machine-readable data) were defined. The document was launched in 2018 and ratified by 13 Flemish cities.

To simplify the data access regarding the capital region, Belgium launched a regional platform that aims to centralize information about data and services, the DataStore.Brussels[21]. The platform allows metadata to be consulted or downloaded by everyone for free.

Moreover, the Muntstroom PCP project[22] has been recently initiated in Brussels as a Pre-Commercial Procurement (PCP) regarding R&D of end-to-end solutions for monitoring multi-faceted people flow. To make it possible, four public buyers intervened on the project: the Public transport operator STIB-MIVB, the Regional Informatics Centre CIRB-CIBG, the Regional authority Brussels Mobility, and the Regional agency Parking Brussels. The initiative believes that People Flow Data & Analytics can help with making the region more attractive and easier to circulate. The project is currently in the first phase (Phase 0) where interactions with parties are being developed to better customize the open and shared People Flow data. Regarding standards[23], data collection is expected to be done on open standards (e.g. RTSP, MPEG4, ...). Then, data should be normalized in linked data through open standards (such as RML to facilitate organization and inference via knowledge graphs). Finally, Government should be the provider of which open standards to adhere to. The solution will be finished in 2022.

On the other hand, the City of Antwerp created the NXTMobility Manager project to link different digital mobility systems. The objective is to develop a MultiModal Mobility Manager (M4) to study the use and impact of distinct mobility modes, with special insight on new modes such as shared vehicles. On one hand, this will contribute to governments in

[19] Open data in Vlaanderen platform website: https://opendata.vlaanderen.be)

[20] Smart Flanders, Open Data Charter: 20 Principles, information found in https://smart.flanders.be/open-data-charter/, consulted in December 2020

[21] DataStore.Brussels platform website: https://datastore.brussels/web/

[22] Brussels Intercommunal Transport Company, Muntstroom, information found in https://www.stib-mivb.be/article-pro.html?_guid=90c280fa-8afa-3810-968f-eb0cea5e2307&l=en, consulted in December 2020

[23] Muntstroom PCP Group (2020), Muntstroom PCP – Market consultation report, information found in https://www.stib-mivb.be/irj/go/km/docs/WEBSITE_RES/Attachments/docs/Muntstroom/Market%20consultation%20report_final.pdf, consulted in December 2020

establishing mobility policies. On the other hand, the initiative will help MaaS providers in developing better solutions and final users in finding their best path.

Table 9 - Platforms in Belgium

Platform/Project denomination	Open data in Vlaanderen
Types of data provided	Mobility-related data: road accidents and deaths; bicycle rental; green areas; shared mobility; energy consumption and emissions; public transports or traffic. Other areas: environment, energy, soil use, soil mechanisms, geography, biology and geology, hydrogeology, water, and lakes, among others.
Data origin	Public data from the Flemish government agencies and local authorities.
How is the data provided to users?	Most datasets are in XML format, however, traffic information comprises some datasets in DATEX II. Moreover, the platform redirects some information to other websites.
How is the data updated (frequency)?	Data is static, including datasets from several years. The newest document found in this research was updated 4 days ago (update data is indicated on the website).
Who can get access to the data?	The data is open to the public for free.
Quality Control Mechanism	The website is managed by the Information Flanders agency of the Flemish government, which is responsible for the operational management of the information. I They try to ensure that all information is as complete, correct, comprehensible, accurate and up-to-date as possible. The portal has a specific contact form to users identify any shortcomings and to be solved as quickly as possible.
Operational state	Already operating (launched in 2012).

Ireland: Dublin Region

Dublin is also making progress on its Smart City journey. Four local entities decided to adopt an open data approach to develop new and innovative urban solutions, solve city challenges and therefore improve city life. In this framework, the Dublin City Council, the South Dublin County Council, the Dún Laoghaire-Rathdown County Council and the Fingal County Council joined forces and created the Dublinked Platform[24]. Dublinked currently has available almost 300 datasets comprising a large amount of data on economic and health measures, facilities, and infrastructure, being the Real-Time Passenger Information (RTPI) one of the most popular datasets. The RTPI combines data from different transport modes, updated information on traffic delays and interruptions, and transport capacity, which creates great benefits in choosing a way to travel.

[24] Dublinked platform website: https://data.smartdublin.ie/

Table 10 - Platforms in Ireland

Platform/Project denomination	Dublinked
Types of data provided	Mobility-related data: real-time passenger information; traffic; parking; public transports; bikes sharing/rental/parking; road accidents; signalization; street lightning; location of areas of interest; sustainable indicators; among others. Other areas: arts culture and heritage, environment and energy, planning and land use, government and participation, recreation and amenities, population and communities, public health and safety, and economy and innovation.
Data origin	Local authorities and sensors placed around the city.
How is the data provided to users?	Raw data is provided in more than 30 distinct formats (most on CSV, ZIP, KML, HTML, DB_TABLE, and GeoJSON). Concerning metadata, the template was developed by adapting and enhancing the standard CKAN's metadata template. Also, the platform redirects some information to other websites.
How is the data updated (frequency)?	Depending on the dataset, the platform provides real-time data (e.g. Real-Time Passenger Information, bike-sharing, and parking availability) or dynamic data, being updated according to the entry of new information on data suppliers.
Who can get access to the data?	The data is open to the public for free.
Quality Control Mechanism	In many cases, data already exists but must be found and then cleaned (checked for accuracy and consistency), organized for a specific purpose, saved, shared, and updated.
Operational state	Already operating (launched in October 2011).

Platforms similar to an "Urban Access Point" on a European level: main conclusions

As can be seen, becoming "smarter" is of the utmost importance among the European cities. Cities have recognized the value of big data and how it can be helpful to share it for solving problems, creating innovative solutions, and promoting sustainability and safety. Also, urban data is crucial to improve MaaS applications and help not only citizens but also every person who is visiting the city, which creates great value for tourism and therefore for the city economy.

This research focused on finding and explore platforms created on a European level with the aim of gather and provide urban mobility-related information. The existing platforms are numerous and it is impossible to explore them all on a single document. In this framework, this report aims at conducting a general overview, presenting detailed information on some of the frontrunners on sharing data and developing smart and shared mobility in Europe. Thus, 10 countries were used as an example: Netherlands, Denmark, Spain, United Kingdom, Finland, Germany, France, Norway, Belgium, and Ireland. The extracted information, which will serve as the basis for the design of other systems' architectures, and to define their main needs and overall requirements, can be summarized as follows:

Types of data provided: since the research procedure was targeting platforms focusing on transports and mobility, such as the UAP, some of the presented platforms are only for that purpose including information mostly related to traffic, parking, shared mobility (especially bike-sharing), public transport, signaling and policies, and areas or services of interest. On the other hand, having available mobility-related data was a requirement and not a motive to exclude more generic portals. Thus, other platforms include not only mobility and transport-related data, but also other information found relevant for the municipalities such as environmental data and issues, culture, education, economy, health, or other social areas.

Data source: there are two distinct lines concerning data provision, the data provided by private and/or public entities and the data directly acquired by sensors and other types of road equipment. In the first case, most data is supplied by municipalities and local authorities, which in some cases result in membership of associated public entities. Notwithstanding, it is also common to see private entities collaborating with these kinds of initiatives by providing or treating data, or as targeted users. Furthermore, to acquire, for instance, real-time data it is necessary to make use of technologies such as sensors, placed in strategic locations and more recently, by making use of the potentiality of moving devices such as smartphones or in-vehicle equipment.

How is the data provided to users: big issues are raised when it comes to sharing data with the users. It was verified that not all cities are following the same standards and most information is raw data, published in distinct formats instead of using a single standardized form. It is important to have in mind that some of these platforms are only data/links

repositories but others are operating in real-time, connected with other platforms, systems, or devices. In this case, the interoperability of data among the ecosystem actors should be assured. Also, some platforms should feed their respective NAPs. The prescribed data format for the NAPs is DATEX II, which is the European standard for traffic data. For multi-modal data, the standard according to the ITS Directive (2010/40, 7/7/10) is NeTEX/SIRI. Thus, cities are encouraged to produce data in these formats, consistent with the regulations.

How is the data updated (frequency): it was possible to identify two distinct perspectives concerning the frequency of data exchange: on one hand, some platforms only provide static information, more or less recent; on the other hand, the future of smart cities depends not only on the quality of data but on how updated it is and for that, dynamic and real-time data exchange is fundamental.

Who can get access to the data: the European cities are sharing data mainly for the large public and free of charge, however, some datasets contain sensitive content, which cannot be provided to every user and, consequently, have restricted access.

Quality Control Mechanism: information in this regard was not available for all the platforms under analysis. However, a pattern was found among most of them. Generally, the platforms have a team responsible for monitoring the data and assure its highest possible quality and integrity. Nonetheless, in one case, the service provider claims that it is not responsible for the accuracy of the information and that users use the datasets at their own risk. Another platform gives the responsibility on data quality to the data supplier. Moreover, giving voice to users to give feedback on the data, or to request other kinds of information is also a trend among the platforms. Finally, all platforms mentioned how personal identifiers are treated and how they comply with the General Data Protection Regulation (GDPR).

Operational state: through a simple overview it was possible to identify that most platforms were launched in the first half of the 2010 decade. Yet, more recent platforms were created in the last few years, and are still being created and developed. The most recent projects showed having as the main concern making data exchange as fast as possible by making use of innovative technologies and the potentialities of simple devices such as our smartphones. Notwithstanding, each platform or project has its own purpose and is developed towards distinct end-users and to respond to distinct necessities. Hence, exchanging real-time data, use the most innovative technologies, or feeding MaaS might not be a priority.

Overview on Business Models related to "Data Access Points" and System Architecture

Business models

On one hand, Activity 4.1 is already gathering knowledge from past and current governance and business models for public/private data sharing systems across Europe and Internationally. From another hand, the entire Activity 4.3 focuses on drawing and defining the business models to be followed, which will be exposed at the Data Sharing Protocol. Trying to not overlap the aforementioned activities, this section tries to complement them by providing an overview of the business models that are currently being applied at the specific case of the National Access Points (NAPs). Moreover, the NAP and UAP architectures are compared and the main similarities and differences are outlined.

By analyzing the example of the NAPs, firstly, it is important to have in mind that a NAP is not the same as Open Data. The information provided by (or access through) the NAP must conform to international data standards, such as DATEXII or NeTEX for instance, to ensure harmonization and interoperability. It is also important to have in mind that the EU regulations are only being applied to data that already exists in a machine-readable format.

Moreover, there is a relationship between the NAP and the data suppliers, between the NAP and data users but not directly between data users and data suppliers. The access point

results as an intermediary in the data ecosystem, providing organized information to data users. Figure 2[25] shows how data is exchanged with and without the access point.

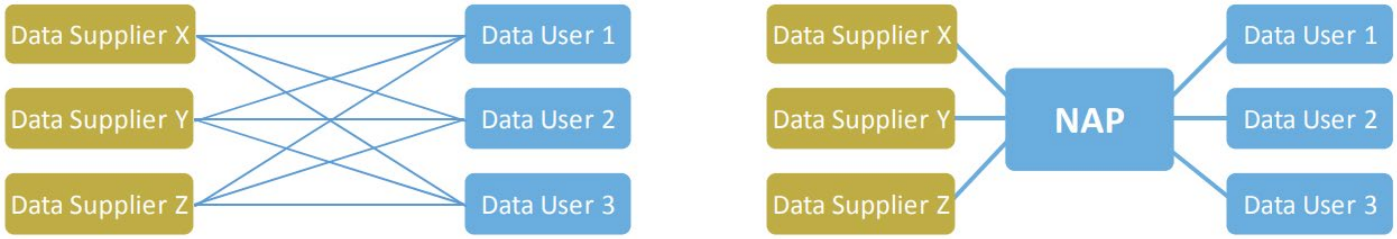

Figure 2 - Concepts of data exchange without a NAP (left) and with a NAP (right)

In that frame, the services provided by the NAP to data suppliers can be listed as follows:

- Technical and operational support with quality assurance (analysis, recommendations, monitoring) by converting the raw data into the European standard format.
- Legal harmonization for the conditions of data use and guaranteeing of a license, contract, registration by login, or a signed agreement.
- Data agglomeration: if a data supplier already has its open data portal, the NAP can act as a repository, giving access to the stored data.
- Establishes direct contact with data users, who do not need to communicate directly with each data supplier.
- Automatic data conversion to the NeTEx profile to facilitate compliance with regulatory obligations by data producers.
- Automatic data conversion to SIRI-Lite format. Most NAPs use the GTFS-RT format.
- Use of the server with the possibility of holding streaming data in real-time.

Note that there is still missing a harmonization of costs associated with the relationship between data suppliers and NAPs. At the moment, this interaction payment model is being defined by each NAP.

Furthermore, the interactions between the NAP and data users are the following:

- The NAP has direct contact with data users. To attend to the users' needs, the NAP collects comments on published data and communicates it to data suppliers.
- The NAP offers technical and operational support for data users to guarantee data quality (analysis, recommendations).
- The users can access the server with the possibility of having streaming data in real-time.

The legislation does not impose open/free data, however, since most public authorities are using open data, much of the public authority data provided by the NAPs is free of charge. Notwithstanding, some data exchange has associated costs. These costs are also not regulated and are defined by each NAP. To illustrate the approach, the Netherlands' NAP can require until 1000€ to provide specific services or information. Additionally, the Norwegian

[25] Jorna et al. (2018), National Access Points: Challenges for Success, 25th ITS World Congress, Copenhagen, Denmark, 17-21 September 2018

portal policies stated that the "Usage of data described in the portal shall preferably be free of charge, but the Delegated Regulations allow the owner of the data to impose financial compensation for use".

System architecture

Regarding systems' architecture, both NAP and UAP have a platform that promotes the interaction between data suppliers and data users. However, the operational process differs between them – see Figures 3 and 4.

Concerning the NAP, to assure interoperability, the information should be stored or accessed in a common data format standard: according to the ITS Directive(2010/40, 7/7/10), DATEX II is the standard mandated by the European Commission for traffic information, NeTEx for static schedule data (such as public transport, long-distance coach and maritime including ferry), and SIRI for exchanging real-time information on public transport. When the source of information is in different formats than the above mentioned, the NAP has to guarantee that the end-users receive standardized information. To do that, distinct data converters may have to be created. In these last cases, instead of redirecting the user to the original database (such as when it is in standard formats), to facilitate data exchange, the NAP serves as a repository of the information in the standard format.

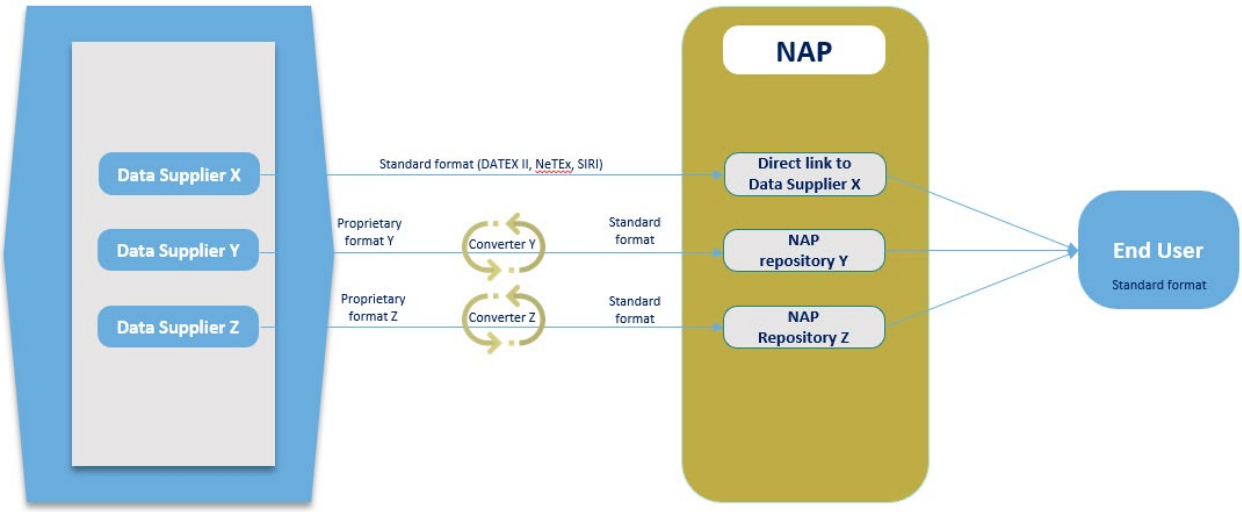

Figure 3 – NAP architecture

On the other hand, the UAP does not have to comply with format standards. The platform works as a "System of Systems" and redirects the end-user directly to the original database, regardless of its format. The project priority does not rely on harmonizing data but on making it available and creating a closed system with relevant data for the city of Lisbon. Notwithstanding, some data suppliers will already work towards having their information harmonized according to European standards.

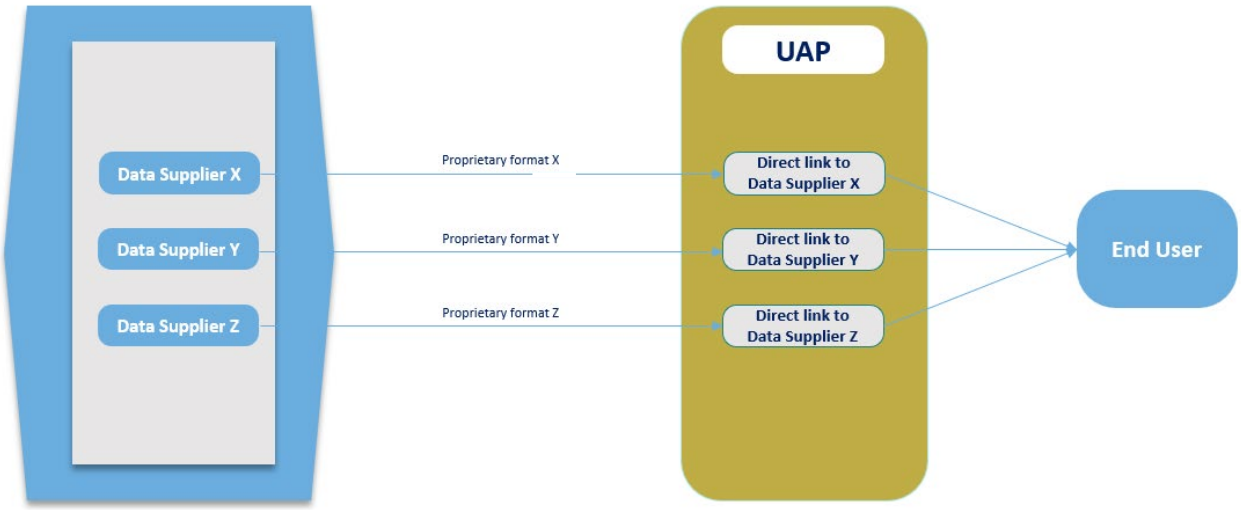

Figure 4 – UAP architecture

Urban Access Points relevant regulations and standards

To help make data available and searchable for pan-European service suppliers, to ensure data to be machine-readable, and to ensure a common understanding of the information provided, it is crucial to have harmonized data, respecting the EU Data Standards. Moreover, the compliance of such rules should be guaranteed by a declaration of compliance in distinct formats and languages and compiling a variety of rules and requirements.

Since the objective is to have interoperability of data crossing, it is required to have a common understanding of metadata usage. Ideally, every human and every machine should search and access harmonized metadata regardless of the access point. To do that, the European ITS Platform already developed a strategic Metadata Guideline, that is being respected by the National Access Points[26]. Moreover, in 2010, the ITS Directive (2010/40, 7/7/10) aims at helping in the correct development of intelligent transport systems (ITS) and to assure the continuity of services. In this framework, several Commission delegated regulations were also created, including the Real-time Traffic Information (RTTI) (2015/962, 18/12/14) and Multimodal Travel Information Services (MMTIS) (2017/1926, 31/05/17), which are especially interesting for city authorities.

In the context of the VoxPop project, compliance with standard formats is not an obligation, however, this section was created to provide relevant information on regulations and data standards being currently applied at the European level. For most data, e.g., road status, signalization, incidents, traffic flow, etc., the DATEX II data model is used. DATEX II is an electronic language widely used in Europe for the exchange of traffic information, allowing this information and management to be distributed in a way that is not dependent on the language and format of the original data. At the first stage, DATEX II was only applied to motorways, nonetheless, efforts are being made in "urbanizing" it within the DATEX II community and the European standardization body CEN. However, some challenges arise in this matter. For instance, data suppliers need to assure the update of detailed data, in a compatible manner, to result in consistent information for data users. Thus, further standardized profiles and certain assistance to DATEX II users may be needed. For the case of Public Transport Network topology and timing concepts, the NeTEx standard is preferred. This standard treats information related to schedules, routes, taxes, etc., and was introduced to ease the data collection and interaction with data suppliers. Finally, the SIRI is applied for

[26] Hendriks, L. et al. (2019), EU EIP SA46 Annual NAP report - 2018 - Monitoring and Harmonisation of National Access Points in Europe

exchanging real-time information on public transport, such as changes in schedules, the real-time vehicle's position, or the time it should arrive at the stop according to the momentaneous conditions. Another challenge relies on data privacy. In the last two years, the GDPR became more rigorous, which had great impacts on many aspects of public life and business. Thus, when it comes to regulation, it is critical ensuring data security and privacy, respecting the GDPR requirements, and providing a transparent data policy. Also, it has to be clear that data is only used for cities and citizens to benefit.

DATEX II profiles

DATEX is an acronym for "DATa EXchange for traffic management and travel information" and was developed to ensure communication and exchange of standardized traffic information between traffic centers, service suppliers, traffic operators, and media partners.

Technically, DATEX II is eXtensible Markup Language (XML) based, which means it is interoperable and extensible, therefore not depending on programming languages or presentation forms. Moreover, the system defines a set of rules for encoding documents in a machine-readable format for both machines and humans. DATEX consists of a set of XML standards/scripts for communication and almost any development technology can be used to produce or consume DATEX II.

DATEX II is currently in version 3.0 and specifications and supporting documentation can be found at http://www.datex2.eu. DATEX II specifies the model for the interfaces to be developed and three main methodologies, namely periodic push (data is actively sent by the server at intervals of time), push in case of incidence (data is actively provided by the server if changes occur, for example, a new congestion message) and pull (the client sends a request to the server). The main DATEX II applications are:

- Re-planning of routes, network, and traffic management;
- Dynamic speed limit control systems;
- The connection between traffic management systems and traffic information systems;
- Applications for data exchange between vehicles and traffic management, such as V2I;
- Multi-modal transport information systems;
- Applications for data exchange of indicators and network performance;
- Among others...

MMTIS NeTEx profiles

From a practical point of view, the NeTEx needs to be anticipated by the profile needed for MMTIS NAPs covering all needs of a Member State, it is advised to incrementally building the national profile for public road transport, by modules. The first step should be to engage all the relevant stakeholders, i.e., the data suppliers. Such initial engagement in the earlier stages will ensure the quality and consistency of the data. Such a two-way communication process provides a mechanism for exchanging information and promoting stakeholder

interaction with the technical teams responsible for developing the NeTEx profiles and/or NAPs for Delegated Regulation (EU) 2017/1926, MMTIS. The second step is a thorough analysis of all the potential data elements involved, as well as the relevant exchanges between different identified application elements. This provides a focus on relevant parts of the NeTEx standard, and a first idea on the options, values, and parameters relevant for the applications. Once these have been identified, the profile can be completed. In summary, the main difficulties Member States face while developing the respective MMTIS NeTEx profiles seem to fall into three main categories:

- The size of the task at hand;
- Reach an agreement on elements involved;
- The quality of the data available.

NeTEx profiles for passenger information are already available in Austria, France, Finland, Norway, Germany, and the Netherlands. Each national NeTEx profile must, naturally, comply with the common minimum European profile developed within TC278/WG4/SG9. This profile is a "minimum" profile for passenger information, covering all needs shared by member states.

The implementation of Delegated Regulation (EU) 2017/1926 MMTIS is supported by:

- CEF Programme Support Actions (PSAs), such as the recent IDACS and DATA4PT projects;
- Individual Standardisation Activities, such as INSPIRE-MMTIS Project or TN-ITS Extension;
- MMTIS Stakeholder workshops;
- Other studies/activities, such as the recent Persons with Reduced Mobility (PRM) study;

The “DATA4PT - Data for Public Transport” European Project – PSA under the CEF Transport to support Member States in the development and deployment of European public transport data standards Transmodel, NeTEx and SIRI for the provision of Union-wide multimodal travel information services”, started recently, bringing together nine Member States; the specific objectives of the project include:

- Support the technical development of Transmodel, NeTEx and SIRI to fulfill the needs of MMTIS suppliers,
- Develop data validation tools and test platform,
- Conduct required updates for all standards,
- Assist the development of National SIRI profiles,
- Facilitate the operational use of Transmodel, NeTEx and SIRI standards by Public Transport Operators and Public Transport Authorities,
- Exchange of best practice.

One of the key actions of the project is the setup of an expert team to be able to support any project using Transmodel, NeTEx or SIRI in Europe, providing and supporting the

Member States for writing national profiles, and train new experts. The project will also provide validation tools, a test platform and specific training.

The IDACS, "ID and Data Collection for Sustainable fuels in Europe", is the PSA "Data collection related to recharging/refueling points for alternative fuels and the unique identification codes related to e-Mobility actors" where 16 Member States come together to:

- Set up harmonized e-mobility Identification Codes for Charging Point Operators and e-mobility service suppliers,
- Implement ID registration repository for exchanging information on these e-mobility ID codes,
- Ensure that all data of infrastructure for electricity and hydrogen are made available through the NAPs.

The IDACS project started in January 2019.

Another PSA example is the Portuguese MMTIS Action "How2Go". The objective is to support the early implementation of the delegated regulation under Directive 2010/40/EU by MS, including the public transport authorities, public transport operators, and service suppliers in their territory, for the provision of Union-wide multimodal travel information services which apply to the TEN-T network including urban nodes. In the scope of the project, the national NeTEx is to be developed and the planned NAP will be extended for MMTIS.

The PRM study, Mapping Accessible Transport For Persons With Reduced Mobility, aimed at assessing whether the digital travel information systems are providing information on the infrastructural accessibility conditions to/from transport services that allow PRM users for informed decisions on their travel plans and how this could be enhanced. The study designed and conducted a pilot experiment involving an interactive web-map travel information and journey planner application. The pilot demonstration was evaluated in three different contexts:

- A cross-border scenario, involving German and Dutch border (NL/DE);
- A national scope scenario for rail, involving the United Kingdom (UK);
- A last mile scenario, involving the urban region of Lisbon (PT).

The service intended to make use of both public transport information, as well as available accessibility information. The NeTEx profile developed in the context of this pilot is an important milestone and brings also added value for those working in this field, addressing a possible common set of attributes and improving the feasibility of future PRM projects.

VOXPOP

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