TANGENT

POLICY, REGULATORY AND PLANNING FRAMEWORK FOR TNM. FIRST RELEASE.

D1.4

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Executive summary

This deliverable, being a first release of policy and regulatory framework on traffic network management, the D1.7, will mainly provide a preliminary analysis of the planning and regulatory framework in each TANGENT city, as well as at national and EU levels, towards the effective integration of Network Traffic Management solutions and multi-actor cooperation models in local sustainable urban mobility planning processes.

It will aim at providing preliminary guidance to cities across EU to effectively address the challenges of Network Traffic Management in connected, cooperative and innovative transport systems, by developing pathways of reflection towards developing a Network Traffic Management planning framework.

These The two deliverables on the subject, D1.4 and D1.7, will aim in the end at strengthening the capacities of local authorities and mobility stakeholders to assess and set up optimal multi-actor

implementation.

Key words

Network traffic management, planning, regulatory framework, sustainable urban mobility planning, sump, transport modelling

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List of abbreviations and acronyms

Acronym	Meaning
AML	Lisbon Metropolitan Area (Área Metropolitana de Lisboa)
AOM	Autoritée Organisatrice de la Mobilité (Authority Organising Mobility)
ASAP	As Soon As Possible
AV	Automated Vehicles
B2B	Business-to-business
B2C	Business-to-Consumer
CAVs	Connected and Automated Vehicles
CCAM	Cooperative Connected and Automated Mobility
CCO-M	Centro de Controlo Oparacional da Mobilidade (Operational Mobility Control Centre)
C-ITS	Collective - Intelligent Transport Systems
COI	Centro Operacional Integrado (Integrated Operational Centre)
CREL	Circular Regional Externa de Lisboa (Lisbon Regional External Circular Road)
CRIL	Circular Regional Interna de Lisboa (Lisbon Regional Internal Circular Road)
DIRO	Direction Interdépartementale des Routes Ouest DIRO (Interdepartmental Directorate of West Roads)
DRT	Demand Responsive Transport
EC	European Commission
EC	European Commission
ECA	European Court of Auditors
EEA	European Environmental Agency
EMEL	Lisbon Mobility and parking company (Empresa de Mobilidad e Estacionamento de Lisboa)
GA	Grant Agreement
HGVs	Heavy Goods Vehicles
IoT	Internet of Things

ITS	Intelligent Transport Systems
KDK	Traffic Management Centre of the Attica Region
KoM	Kick-off Meeting
KPI	Key Performance Indicator
LCVs	Light Commercial Vehicles
LMA	Lisbon Metropolitan Area
MaaS	Mobility as a Service
MMTIS	Multimodal Travel Information Services
NAPs	National Access Points
NPSE	Transport Project provider companies
NTM	Network Traffic Management
O.SY	Road Communications Services S.A
OASA	Athens Public Transport Authority
PDU	Plan de Déplacement Urbain (Urban Mobility Plan)
PGIL	Plataforma de Gesto Inteligente de Lisboa (Lisbon Intelligent Management Platform)
RTTI	Real-Time Traffic Information
SDAGT	management master plan).
STA.SY	Central Communications Services S. A
SUMP	Sustainable Urban Mobility Plan
TEN-T	Trans European Transport Network
TfGM	Transport for Greater Manchester
TIGA	Territories of Innovation of Great Ambition
WP	Work Package

1 Introduction

1.1 Attainment of the objectives and explanation of deviations

The deliverable ,
which aims to analyse the planning and regulatory frameworks in each TANGENT city, as well as national and European levels, towards the effective integration of new
solutions and multi-actor cooperation models in local sustainable urban mobility planning processes. Building upon partners wide experience with Sustainable Urban Mobility Planning (SUMP) methodology, explained further in Section 4 of this deliverable, TANGENT aims to guide cities across the European Union to effectively address the challenges of Network Traffic Management (NTM) in connected, cooperative and innovative transport systems, by developing a NTM planning framework. This will be done with the D1.4 T and
D1.7 T

The objectives related to this deliverable have been met in full, with some delay due to the prioritisation of capacities for other deliverables. This decision was made based on the little implication that delaying this deliverable would have on other project activities at this stage.

1.2 Intended audience

This deliverable mainly addresses policy-makers to provide support in setting up institutional and planning frameworks for the integration of new NTM solutions and multi-actor cooperation models. It also addresses local authorities and planning practitioners to support the setup of local frameworks.

1.3 Structure of the deliverable and links with other work packages & deliverables

This deliverable is structured in five sections. After this brief introduction to the deliverable, the second section illustrates the state of the art of planning and regulatory frameworks for NTM solutions in Europe and highlights key findings of previous research projects on the topic. The third section provides an overview of the planning and regulatory framework in each TANGENT case study, at the city, regional and national levels. Then, section four studies key elements for effective network traffic management planning, based on the Sustainable Urban Mobility Planning (SUMP) methodology. Finally, the fifth section reflects on the performed analysis to identify the main challenges and limitations for NTM planning and implementation, derive conclusions and recommendations, and define the next steps in Task 1.4.

This first release aims at setting a first understanding of the planning and regulatory frameworks in each TANGENT city, as well as their national level and at the European level, towards the integration of NTM solutions and multi-actor cooperation in local sustainable urban mobility planning processes. It aims to identify the first set of challenges in the definition of planning and regulatory frameworks that could prevent the effective integration of new NTM solutions and multi-actor cooperation. The second release of the deliverable (D1.7) will further develop and confirm or dismiss these first observations.

Deliverables D1.4 and D1.7 are also linked to D8.5 , as part of Task 8.5
policy document targeted at public authorities that describes the link between multi-modal network management and policy and makes recommendations on how multimodal network management can be integrated into policy and planning processes.

2 Planning & Regulatory framework for NTM solutions & multi-actor cooperation models

European transport faces major challenges in terms of safety, greenhouse gas emissions, traffic congestion and its negative externalities. In addition, the development of disruptive technologies and the emergence of new mobility solutions generate a revolution in the transport network and traffic management. In this context, TANGENT aims to develop new complementary tools for optimising traffic operations in a coordinated and dynamic way from a multimodal perspective and considering automated/non-automated vehicles, passengers and freight transport.

TANGENT will research advanced techniques in modelling and simulation, such as prediction and simulation models for future demand & supply of transport; optimisation techniques for balancing the demand flow between the means of transport; and users travel behaviour modelling.

As result, a set of applications for decision-making support will be delivered creating a framework for coordinated traffic and transport management, encompassing an enhanced mobility information service and dashboard with associated APIs and advanced functionalities with a two-fold approach: (1) to provide real-time traffic management recommendations, and (2) to support transport authorities to design network-wide optimal strategies.

The framework also aims at supporting a multi-actor cooperation approach for transport network management by enabling communication channels. In this way, the services target different actors in traffic management. The results will be tested in three case studies: Rennes (FR), Lisbon (PT), Great Manchester (UK) and a virtual case study in Athens (GR) with real data from various modes of transport, under different traffic events such as bottlenecks, accidents, pedestrian flow etc.

2.1 Background and review of the discussions on NTMs

13 projects (listed below) have been identified as contributing to TANGENT objectives in the scope of network traffic management and multi-stakeholder collaboration. Key findings are summarized below and information about each project is available in tables in Annexe 1.

- CH4LLENGE - Addressing key challenges of sustainable urban mobility planning;
- CIMEC - Cooperative ITS for Mobility in European Cities;
- CoExists - Enabling cities to get "automation-ready";
- DIT4TraM - Distributed Intelligence & Technology for Traffic & Mobility Management (ongoing);
- FlexCurb - Transforming the curb side through flexible use and management (ongoing);
- FLOW - Furthering Less Congestion by Creating Opportunities For More Walking and Cycling;
- FRONTIER - Next-generation traffic management for empowering Connected and Automated Vehicles (CAVs) integration, cross-stakeholder collaboration and proactive multi-modal network optimization;
- GECKO - Governance for New Mobility Services;
- LEVITATE - Societal LEVel Impacts of connecTed and AutomaTed vehiclEs;
- MAVEN Managing Automated Vehicles Enhances Network;
- MOMENTUM - Modelling Emerging Transport Solutions for Urban Mobility;
- ORCHESTRA Establishing a Common Understanding of Multimodal Traffic Management Concepts and Solutions, with and Across Modes, for Various Stakeholders and Multiple Contexts;
- POSSE - Promotion of Open Specifications and Standards in Europe.

There have been three main cooperation models found previously for private-public partnerships: memorandum of understanding (MoU), formal contract, and informal information sharing. Each of these

forms encounters common challenges that have been tackled in many ways in the past and can serve as a lesson for future implementations. As commonly seen in previously carried executed projects (e.g., GECKO), a complex network of stakeholders in the context of implementing transport solutions is often difficult to navigate. Among the most common barriers to for cooperation are differences in objectives between the public and private sectors; lack of technical competencies and understanding on part of the public sector; hidden commercial interests of the private sector jeopardizing trust; false expectations related to the technology created through a lack of understanding or hype; and lack of platforms or forums to engage in collaboration have been indicated.

The Horizon 2020 GECKO project aimed to support authorities with tools and recommendations for the development of new regulatory frameworks to accompany the new mobility era. A key element in this effort was building evidence via research regarding existing regulatory responses and governance models related to disruptive innovation for mobility. On the topic of Network and traffic management, at are developed for the traffic management, but also

(Busquet at al., 2019). This is towards the identification of governance and regulation trends and models to address such innovations, illustrating them with three relevant case studies.

The FRONTIER project produced a tool for multi-stakeholder partnerships that provides (among others) a framework for developing arbitration models for tackling vehicle planning and traffic management problems that involve multiple partners. Authorities can also use innovative, collaborative business models which aim to create, share and capture value across different actors and stakeholders that are resulting from FRONTIER as well as collaboration and data management models that allow accommodating the increased needs of data sharing, traffic management, resilience and response to complex events, safety and security.

Among project partners, a clear definition of partners with associated responsibilities and the task should be prepared upfront for the project implementation. That will allow for avoiding uncertainties and situations in which clarity of whose authority is to make the decisions is lacking. Processes and procedures must be known and accepted by all involved parties and the whole process should run in full transparency between partners. CH4LLENGE project defined the four most pressing challenges in sustainable urban mobility planning (participation, cooperation, measure selection, monitoring and evaluation) and produced a framework that can robustly support cities in conducting activities in this area (figure 1). Additionally, platforms that bring together public and private parties; living labs and neutrality commissions to help break silos at a vertical level and a horizontal level for public-private cooperation; providing legislation and regulation from public authorities; and sharing anonymized data with the private sector for business development are solutions that can help improve cooperation among public and private parties.

is key for a successful implementation of new technologies (e.g., MAVEN). To ensure sufficient time for the users to get accustomed to new solutions, transition periods were often implemented. When planning for the policy, an action plan for all planning horizons should be prepared (operational, tactical, and strategic roadmap). As a way of improving the acceptance, collaborative planning with citizens and all relevant stakeholders, involving them in all steps of the projects with clear communication strategy have been indicated as facilitators. Among the actors that benefit to be involved in the cooperation process, it can include: third-party authorities; end-users; households; associations and researchers but also non-users have been mentioned. Cities need to be open for debate, ready to answer questions and proactively reach out for transparency in the process.

Figure 1. Challenges in developing SUMP (source: CH4LLENGE)

Attention should be paid to the timeline of the process - standards and official regulations often come after technological developments which pose certain challenges. Firstly, market-available solutions are not as easily scalable and easy to implement when the relevant regulatory measures are missing. That impacts also the modularity of available solutions, potentially increasing the costs of implementation and further maintenance. As result, it might also constrain the future possibility of changing a provider. Moreover, lack of regulation limits the reaction strategy in case of political backlash. POSSE project tackles specifically the use of open specifications and standards in traffic management to avert vendor lock-in and promote a healthy marketplace.

Implementation of new transport measures should be considered in the larger framework of local policy goals regarding mobility and not as an isolated activity. Authorities should look at planning for innovative transport solutions as an element of a more fundamental change process. As found in CoExist and FLOW, such planning should be based on multimodal analyses and done proactively, tailored to the city's needs and not exclusively to international frameworks. The need for a multimodal approach to traffic management and its governance has been also the core of ORCHESTRA project. As indicated in the findings of the abovementioned sources, transport and infrastructure planning must be conducted through adequate tools (e.g. modelling) and consider functionalities & impact assessment framework, with strategically defined Key Performance Indicators in relation to local policy goals.

In the context of infrastructural requirements, data-feeding solutions have been found crucial. Digital infrastructure with access to signal phase, timing and topology data as well as roadside sensors for the detection of different traffic participants have been found beneficial. Data is key to assessing new mobility solutions, however, a large proportion of data is still not available and has to be generated.

There exist also barriers to sharing data between public and private actors due to the lack of standards; the lack of willingness to share data by the private sector due to business interest; and privacy issues.

Furthermore, key experiences in the implementation of advanced traffic management systems can be highlighted. The Traffic Management 2.0[1] (TM2.0) innovation platform, launched by ERTICO in 2014, aims at promoting and accelerating the Intelligent Transport Systems in Europe. Its objective is to create a Collaborative and Interactive Traffic Management System, by developing synergies between the public authorities, the private service providers and the drivers. In the framework of this project, TM2.0 tackles interoperability issues by selecting the data formats, and the services required for advanced navigation services, adaptive and dynamic traffic control, traffic status and event detection. TM2.0 works to push the cooperation between private and public parties and propose innovative schemes and architectures.

Regarding Traffic Management Systems, data integration and processing are challenging to adopt a data-driven approach, as they are miscellaneous and come from many sensors. Data needs to be standardized, synchronized and exploited properly (with new traffic models) to bring valuable information and improve traffic information quality, to give appropriate alternative route guidance. To achieve this goal, as we will see in the TM2.0 case study, a new architecture must be defined to adopt a Cooperative, Connected and Automated Mobility, through the development of Cooperative Traffic Management Services. In addition, the use of personal data must be managed in agreement with policies. The end-users will be important actors in the traffic management system, exchanging data with traffic management centres and service providers.

2.2 Overview of the regulatory framework

2.2.1 International scale

On the international level, the United Nations Economic Commission for Europe (UNECE) has been a pioneering organisation working on traffic management initiatives since 1950. Through its Global Forum on Road Traffic Safety (UNECE, 2022), UNECE has contributed to the definition of harmonized international agreements and conventions regarding traffic, focusing on the improvement of road safety through standardised regulatory frameworks and conventions. Moreover, concerning the regulation of innovative mobility services and technologies, the
Vehicle Regulations (UNECE, 2018), and its Working Party on Automated/Autonomous and Connected Vehicles, work on the development of technical provisions for automated vehicles.

2.2.2 Regulations on NTM at the EU level

the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport basis to support coordinated and coherent deployment and use of Intelligent Transport Systems (ITS), specifically in the international context. It is currently the most binding legal framework concerning Network Traffic Management. Although for the time being, there exists no Europe-wide legislation that requires a specific approach to traffic management systems, Directive 2010/40/EU, mandates the use of DATEX II for most of the outputs (or compatible standard). In the European context, DATEX II is the principal framework for traffic management, which structures the format of data relevant to traffic management -use and update of road and traffic data by road authorities, road operators and service providers for the provision of EU-wide real-time traffic (Directive 2010/40/EU, 2010).

The Directive is currently under revision intending to enlarge its scope to emerging mobility services (automation, multimodality, Mobility as a Service (MaaS), Cooperative Connected and Automated Mobility (CCAM) etc.) and geographic extension. The revision, among others, also includes an

[1] TM2.0: TF8: The exchange of Traffic Management Plans in TM2.0,

obligation to collect necessary data and to include real-time information about accidents and traffic obstructions. The ITS Directive empowers the European Commission to adopt delegated regulations, consisting of specifications and other requirements to achieve the goals of the ITS Directive.

A directive is a legal instrument that establishes goals or results to be achieved among Member States. The directive itself does not determine how these results should be achieved and it is up to Member State to decide how to transpose directives into national laws. To supplement existing legislation, delegated regulations are used. Delegated regulations are used typically for the technical aspects of a directive to supplement a legislative act on its non-essential parts or amend non-essential elements. Delegated regulation cannot broaden the scope of the legislative act. A delegated regulation is a legally binding instrument that applies to all member states. It is similar to national law in terms of the impact and direct effect it generates.

Most of the delegated regulations of the ITS Directive specify the data (existing already in electronic formats) that must be made accessible on the National Access Point (NAP). In the context of TANGENT, two of the ITS delegated regulations are especially relevant: Real-time Traffic Information (RTTI) (EU, 2015) and Multimodal Travel Information Services (MMTIS) (EU, 2017).

RTTI was initially adopted in 2014, with application limited to Trans European Transport Network (TEN-T) and motorways. The revised version from early 2022 extends it to all roads. The revision introduces many new data sets, mostly applicable to data held by public authorities. The concept of crucial data sets has been introduced in the revision, which has an earlier enactment date and may become mandatory if the revised ITS Directive retains the data creation mandate. Two new provisions of the revised RTTI are particularly relevant to TANGENT: (1) obligation for traffic regulations/restrictions and traffic management plans to be integrated into the driver information services (e.g., routing information) where accessible (published) on the NAPs; and (2) public authority access to in-vehicle data under FRAND (fair, reasonable and non-discriminatory) conditions for specific public authority transport management tasks.

MMTIS was adopted in 2017 and provides the requirements to develop EU-wide multimodal travel information services. The creation of NTM requires data to be shared between different stakeholders in a high-quality, interoperable format hence MMTIS is crucial for TANGENT. The document supplementing Directive 2010/40/EU distinguishes two main data categories: static or dynamic travel and traffic data, further classified into three Levels of Service. This data must be made available by the Member States through the National Access Points (NAPs). The act ensures accessibility, exchange, and update of standardized traffic information. This delegated regulation is expected to be revised in 2023.

In light of the delegated regulation, the exchange of static data should be using the CEN data exchange standard NeTEx CEN/TS 16614 (based on the underlying conceptual data reference model Transmodel EN 12896: 2006 and subsequent upgraded versions). For the exchange of dynamic data, the relevant parts of the CEN public transport data exchange standard SIRI CEN/TS 15531 and subsequent upgraded versions should be used. Alternatively, any machine-readable format fully compatible with the above-mentioned standards by the agreed timeline can be used. All data standards considered in the MMTIS are summarized in table 1 (Bourée et al.,2019).

Type of data	Data standard	Description
Road	DATEX II	DATEX II defines a common set of data exchange specifications to support the exchange of traffic and travel information seamlessly interoperable across boundaries, including national, urban, and interurban road administrations, infrastructure providers, and service providers.
Rail	TAP-TSI	The Commission Regulation (EU) 454/2011 addresses the railway undertakings, rail infrastructure managers, and ticket vendors to standardize the data exchange for timetables, fares, reservation messages, and operational messages between railway undertakings and infrastructure managers.
Air	IATA	IATA is a trade representing 82% of total air traffic. IATA is currently developing the Airline Industry Data Model (AIDM) which aims to become a single point of access to store: industry-agreed vocabulary, data definitions and their relationships, and related business requirements. The objective of AIDM is to allow the generation of interoperable messaging standards related to passenger services.
Spatial	INSPIRE	The INSPIRE directive (2007/2/EC) of the European Parliament and the Council establishes an infrastructure for Spatial Information in the European Community. Several texts have been produced to support the INSPIRE objectives, such as the technical Guidance for the implementation of INSPIRE dataset and service metadata based on ISO/TS 19139:2007 (02/03/2017) and policies or activities which may have an impact on the environment. It addresses 34 spatial data themes, one of them being Transport Networks.
Public Transport	Transmodel	The European Public Transport Reference Data Model provides reference data structures to express the semantics of the public transport domain. It covers 8 parts: common concepts; public transport network; timing information/vehicle scheduling; operations monitoring & control; fare management; passenger information; driver management; management of information & statistics.
	Nex	Network and Timetable Exchange (NeTEx) is a data exchange standard (provided using XML) for the public transport network, timetables, and fares.
	SIRI	Standard Interface for Real-time Information (SIRI) is an XML protocol allowing to exchange of real-time information about public transport services and vehicles.

Table 1. Data standards mentioned by the MMTIS

3 Planning & Regulatory framework in TANGENT cities & countries

This section builds on the input of the first three rounds of workshops and additional findings resulting from desk research, with the cooperation of TANGENT case studies. The goal of this section is to portray the planning and regulatory framework surrounding network traffic management innovation in place in each TANGENT case study at the city, regional and national levels.

3.1 Rennes

Rennes Métropole is a grouping of 43 municipalities (among which is the city of Rennes, the capital of the Brittany region). Métropoles are public authorities enabled by the law of December 16, 2010, and consolidated by the law of January 27, 2014. Métropoles must gather more than 400 000 inhabitants upon their creation. Rennes Métropole population was 444,723 in 2014 (of which 219,370 were in the capital city of Rennes). Rennes Métropole is experiencing significant population growth, with a forecast of 100,000 additional inhabitants in 2040.

Rennes Métropole was created in January 2015, replacing the previous *Communauté d'agglomération de Rennes*, which had itself succeeded in 2000 the previous "Rennes district", created in 1970. French Métropoles are in charge of their territory, economic development and territorial planning, waste management and water management, housing policy, culture policy and, finally, mobility, transport, and road infrastructure.

Rennes Métropole, as the Authority Organising Mobility (Autoritée Organisatrice des Mobilité AOM), defines the overall transport strategy in its territory through its Urban Mobility Plan (Plan de Déplacement Urbain PDU) and consequently organises the public transport policy in its 43 municipalities. To promote sustainable mobility throughout the territory, Rennes Métropole is implementing a set of solutions favouring public transport and developing complementarity between the different modes of transport, with a clear choice for innovation and experimentation. Along with a policy of strategic planning, Rennes Metropole developed 2017 to 2021 the InOut initiative around new mobility to support demonstration and experimentation. As an annual event, InOut brought together national professional mobility actors ("in") for networking, conferences, showing and facilitating experimentation as well as the public through a dedicated event ("out"), where citizens could learn and experience new mobility solutions.

The figure below shows the main policy orientations and challenges of the PDU.

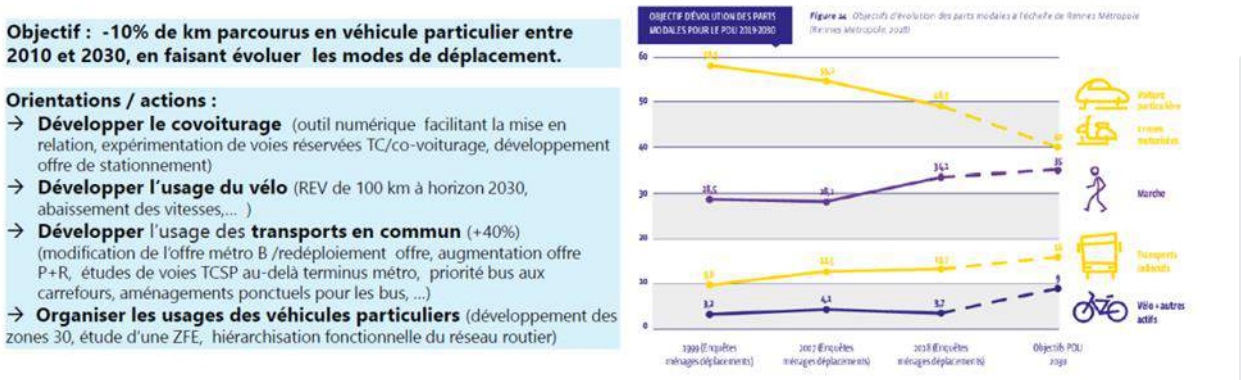

Figure 2. Policy Orientations of Rennes Métropole

3.1.1 National planning framework

took place across the 2010s which resulted in identifying key challenges such as:

- Difficulties in developing new road use;
- Budgetary constraints for investment and maintenance;
- Recurrent congestion of the main road network.

But it also led to identifying key opportunities in improving network traffic management

- Possible gains by optimising existing infrastructure with incentives for the development of dynamic traffic management measures;
- Improving mobility in large peri-urban areas[2];
- Using dynamic traffic management measures as quicker responses than heavy investments to act on congestion in agglomerations, and facilitate the pathway to more sustainable modes (e.g. shared mobility, intermodality, public transport).

The Ministry for the Environment, Energy and Sea has instructed every urban area of more than 250 00 inhabitants with a core road network consisting of sections of the National Road Network (without a concession with motorway characteristics)
G the

approved or in progress. The organisation of the SDAGT should be developed under the authority of the prefects coordinating road networks in collaboration with other local authorities.

The objectives of this planning framework are to (Sproni & Mitrano, 2017):

- Develop a common culture of mobility at the level of large conurbations and share coordinated objectives between the different actors (Public Transport Authority, road managers, ...);
- Achieve a coherent set of optimization projects on the structuring of the road network around large conurbations, taking into account the orientations of planning documents;
- Give priority to traffic management and road sharing measures whose costs and delays make them real short- or medium-term alternatives to new infrastructure projects;
- Have a multi-annual programming tool for traffic management operations for the State (global vision) with the first horizon of 5 years;
- Improve the mobility offer (reliability of the road network, performance of public transport, legibility of the intermodal offer from the road network, etc.) and support the development of new mobilities (carpooling, car sharing).

3.1.2 Regional planning framework

Rennes SDAGT, for the urban area of Rennes and Nantes, is currently being developed by the Direction Interdépartementale des Routes Ouest DIRO (Interdepartmental Directorate of West Roads) in close collaboration with local metropolitan authorities (Nantes Métropole and Rennes Métropole), the regional authority, Departmental Council and local road authorities.

The working group is currently setting up the scale of the SDAGT, identifying the stakeholders involved, the road network to consider and the existing partnerships. It aims at defining a collaborative tool to improve network traffic management in the urban area and provide a tool for data sharing, collaboration and mutualisation.

[2] Spaces between the city and the countryside, in the urban fringe

3.1.3 Local planning framework

The analysis of (Rennes Métropole, 2019), which covers the period of 2019-2030, in terms of the framework provided around network traffic management shows a certain vision to implement definitive and experimental actions in terms of NTM. A congestion observatory in connection with the traffic management and operation system common to the State and Rennes Métropole and the Rennes Métropole traffic management control centre is planned to be modernized. A tool for traffic management and the optimization of the functioning of the structuring road network, the Rennes Traffic Management Agglomeration Master Plan (SDAGT) - is currently being developed by the State services. It will aim to meet several challenges concerning the functioning of road mobility:

- seek solutions to limit regular congestion (southern and western ring roads of Rennes);
- act for more performance of public transport (penetrating in particular);
- develop intermodality practices;
- encourage new mobility (development of carpooling);
- promote a dynamic partnership for road operation and the dissemination of information to users.

3.1.3.1 Connected, Cooperated and Automated Mobility

A particular focus on autonomous vehicle innovation regarding NTM is also noticeable
mobility plan. This focus appears to be motivated by the understanding that shared autonomous vehicles, combined with better management of traffic and road congestion can provide a coherent and sustainable mobility system. The plan aims at preparing Rennes Metropoles for the arrival of autonomous vehicles and supporting their deployment. Beyond this legal and technical monitoring, Rennes Métropole intends to participate in these developments and verify their acceptability by the inhabitants and users of the territory.

Beyond these experiments, it is necessary to think about the place that these autonomous vehicles will have in the local mobility system. Rennes Métropole has thus proposed, as part of the call for expressions of interest Territories of Innovation of Great Ambition (TIGA), the establishment of a Living Lab for autonomous mobility.

3.1.3.2 Mobility as a Service

Another particular focus on MaaS is also visible, motivated by the need to
offering them access to all the possibilities to move via a single subscription and platform. MaaS is considered one of the major challenges .

This multimodal mobility concept is already underway in Rennes Métropole, notably through the deployment of the KorriGo Services card. This is the support of travel for metro users, buses, self-service bicycles, carsharing, etc. It is also the map of travel on the BreizhGo network (TER, interurban lines) and on several other Britain urban networks.

This approach is also part of a sustainable development objective by offering a single support to access different transport networks and services, thus avoiding the multiplication of cards, tickets or other media, while respecting the privacy of residents (Citizen Multiservice Application standard validated by the CNIL).

3.1.3.3 Multi-actor cooperation

In terms of multi- s on stakeholder engagement and participation in the evaluation of actions because it makes it possible to integrate fundamental dimensions such as pluralism (by integrating the diversity of legitimate points of view), participation (by associating recipients and stakeholders), and to build projects in a co-construction approach that federates the actors.

3.2 Greater Manchester

Greater Manchester, with 2,7M inhabitants, and an area of 1,276 sq. km, has more than 5,6 million

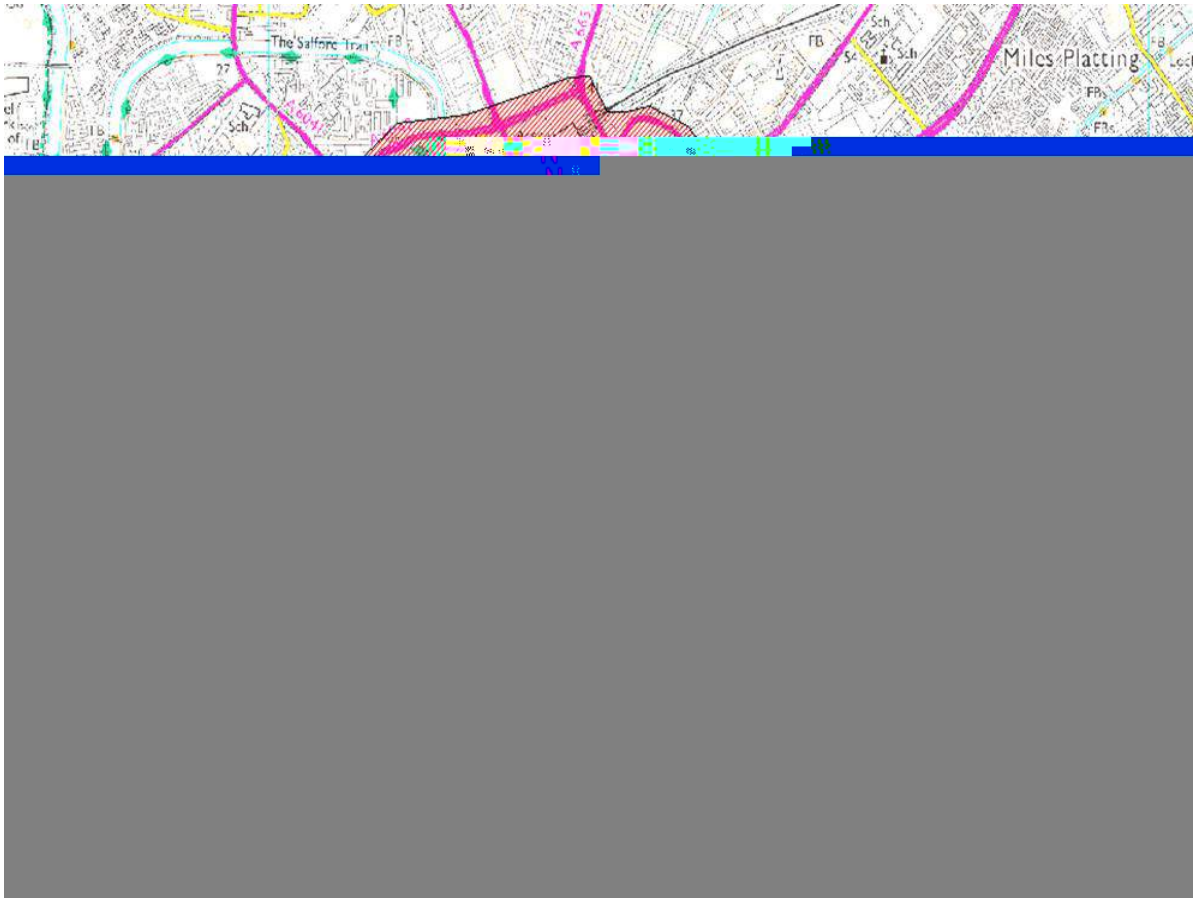

Figure 3. Area within and including Manchester Inner Ring Road.

3.2.1 Transport Planning framework

The perception of Greater Manchester as a good place to live, work, invest and visit is vital to the economy. The city aims to deliver efficient, seamless, intelligent, and easy-to-use public transport compared to other world cities and create public spaces that offer a safe, attractive, and clean environment for walking and cycling. The development of connected infrastructure shared services and placemaking has been at the forefront of the transport innovation agenda for the area of Greater Manchester. Innovation projects are being undertaken to better understand the impact of these services and new mobility solutions and overcome any technical, regulatory, and commercial barriers. Projects such as eHUBS are creating community hubs with access to shared, electric, sustainable mobility solutions, while the legacy of the ground-breaking CityVerve project is the foundation of the ambition to be a world-leading smart city.

TfGM and local planning authorities will continue to work with developers to better integrate transport and new development following the principles of:

- Reducing the need to travel.
- Reducing the need to travel by car, and the distance travelled.
- Maximizing accessibility by sustainable modes.
- Making the best use of existing infrastructure, particularly through increasing the density of development close to public transport nodes.
- Maximizing opportunities to provide additional public transport.
- Designing to encourage active travel.

Figure 4. Reinforcing (Greater Manchester Transport Strategy 2040, TfGM, 2017)

The goal is to provide sustainable travel options that offer an attractive alternative to the private car and minimize the negative impacts of freight traffic. Tackling these issues will enable Greater Manchester to deliver its economic growth, and environmental and quality of life goals without traffic congestion and pollution undermining its long-term success. Greater Manchester has adopted an adaptive, vision-led approach to transport planning. This means that the steps needed to achieve the Right Mix vision will be continually monitored and adjusted to achieve the goals.

3.2.1.1 Manchester Transport Strategy

This Transport Strategy 2040 (Greater Manchester, 2017) focuses on the critical long-term challenges we are facing in Greater Manchester, such as global warming, a rapidly growing and ageing population, low productivity, and the need to reduce poverty and social inequality. This is supported by a more holistic approach to the needs of passengers and freight, with a strong focus on integration across different modes of transport, and with wider policy areas, such as spatial planning and health.

Technology and innovation also have a key role to play. Through the 2040 Transport Strategy, Greater Manchester will develop a network approach that would enable them to meet a wider variety of travel demands, facilitating easier interchange at key nodes on our transport network and, along with improved services, enabling people to make orbital, as well as radial, journeys much more easily. The aim is to stop viewing different modes of transport as separate networks, with individual asset management, service planning, and fares and ticketing regimes, and instead plan a single, highly connected transport system that customers can move through seamlessly. This will result in prioritizing transport improvements more effectively, based on the needs of different travel markets and saving resources by minimizing duplication of expenditure and activity.

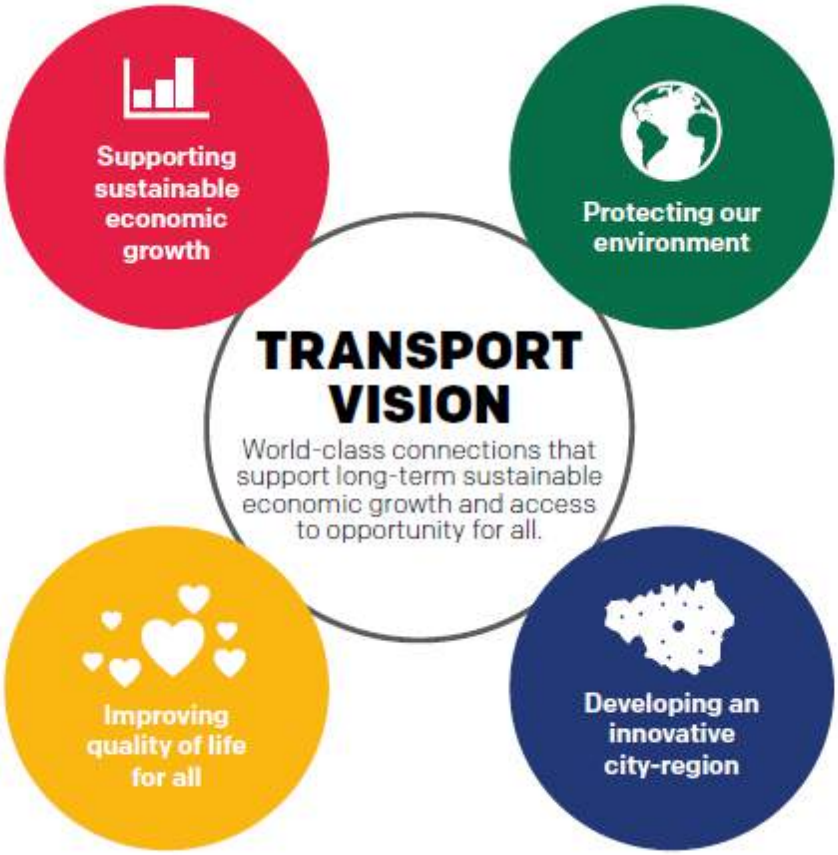

Figure 5. Transport vision of Greater Manchester (Greater Manchester Transport Strategy 2040, TfGM, 2017)

Greater Manchester aims to maintain investment in the bus network and improve public transport connectivity to employment and essential services, as well as improve the customer experience. The demand for public transport, including buses, must grow, facilitating the modal shift from car to public transport, and reducing congestion and harmful emissions. To fully achieve these outcomes, evidence from other cities suggests that improved integration and investment can increase the use of public transport and bring attendant benefits. Improved public transport will need to play a major role in efficient, and well-integrated public transport network is an essential element within the city and at the heart of the *Our Network* vision. Together with active travel, it can provide the significantly enhanced connectivity that city region requires for success. It can encourage growing numbers of people out of their cars for more of their journeys (helping to reduce emissions and congestion), and it can provide access to employment, education, and opportunities for the third of households without access to a car. Modern, high-quality interchanges have been built or are under construction in the main town centres, with provisions for extensive bus priority, through a network of Quality Bus Corridors and the Bus Priority Package.

The Transport Strategy 2040 (TfGM, 2017) has been developed in line with current Local Transport Plan guidance and European best practice in creating Sustainable Urban Mobility Plans. Alongside this strategy, *Our Network* from Greater Manchester is a passenger-focused way of showing how different modes of public transport bus, tram, rail, tram-train - and cycling and walking - could form a modern, integrated transport network with seamless connections, simplified ticketing, and aspiration for capped fares.

Transport is already contributing to regeneration, including through the expansion of Metrolink, which is

transit stops into Mobility Hubs, including better pick up and drop off provision, cycle facilities and electric vehicle charging points. Reducing the impact of traffic by increasing the use of public transport and through effective traffic management, will be essential. It will improve quality of life by reducing noise, severance, and pollution. Locating new development where there is good access to public transport and services will reduce car travel and therefore emissions. Damage to, or loss of, habitats as a result of construction, disturbance from traffic noise or street lighting, and pollution due to run-off from highways should be minimised. s
to create much more pleasant places to live, but brings important environmental benefits through reducing temperatures, noise, and pollution as well as absorbing run-off. Blue infrastructure also contributes to the quality of life by providing attractive, traffic-free routes for walking and cycling.

Traffic speed is a major factor in whether people feel safe to walk or cycle and lower speeds reduce the severity of casualties. There is evidence that where 30km/h zones have been introduced there can be an increase in walking and cycling. On many roads in Greater Manchester, 30km/h speed limits have been implemented and are legally enforceable by Greater Manchester Police. We will continue to implement speed reduction measures where these are supported by residents, prioritising: residential areas, areas around schools, areas adjacent to the local or strategic cycle network, where this will help to create a wider network of safer routes; and areas identified as having a high collision risk for vulnerable road users.

The goal for TfGM is to achieve walkable centres, with pedestrian-friendly spaces, which accommodate access by bike and by public transport but are still accessible by car and are viable for business. Reduced traffic volumes and speeds can greatly add to the vitality of centres, encouraging people to walk for leisure or stop at pavement cafes. The benefits of traffic-free streets must account for the need to maintain access to cars, buses, and services. Many local centres are bisected by major roads, which create noise, pollution and severance as well as presenting a danger for cyclists and pedestrians, particularly children, disabled and older people. While the movement of traffic needs to be accommodated, greater emphasis must be given to the needs of the area or the locality, prioritising pedestrians, cyclists and bus passengers through crossing facilities, improved links and signage from interchanges and car parks, and improved parking for cycles and motorcycles. A noteworthy mention, in this case, could be made of the daily school journeys, which can have a significant impact on local traffic and transporting children to school by car also contributes to reduced levels of fitness and increasing obesity. For journeys to primary school, a switch to more walking or cycling would both reduce traffic in residential areas and improve the health of our young people. Journeys to secondary school are generally longer, but many could still be made on foot or by bike if safer routes and cycle parking were provided. To encourage more school pupils to walk or cycle to school, work with the health sector to promote active travel to schools, including the development of school travel plans, should be prioritised. Shaping those habits in children is a longer-term investment in the future of mobility, creating change in behaviour from an early age.

the services on offer. Park-and-ride facilities will be located carefully as they can lead to people driving further before they start their public transport journey. To improve access in rural areas, TfGM aims to improve the interchanging between rail and bus at rural stations maintaining proper rights of way and bridleways as funding allows. This will be combined with supporting proposals for speed reduction,

and stations; and infill gaps in long-distance walking and cycling routes that improve access to the

countryside. The policies for achieving better-connected neighbourhoods will make it easier for people to travel by sustainable modes, particularly walking and cycling. However, improvements in infrastructure and services need to be complemented by behaviour change measures that encourage people to choose active travel for short journeys, including journeys to school, encouraging the use of local stations, promoting sustainable travel in new developments, and promoting the use of new transport infrastructure.

TfGM will adopt a digital-first approach, with technology increasingly enabling these apps and web-based tools to be tailored to the needs of individual customers making data available as Open Data to allow third parties to develop apps which will benefit the customers. A more consistent approach to transport information and payment to allow customers to search and pay for different travel services, such as public transport, car clubs, cycle hire and parking is to be undertaken. This approach could involve the development of a multi-modal, account-based travel platform, sometimes referred to as Mobility as a Service (MaaS). MaaS could be delivered through a smart card, credit/debit card, mobile phone, or other cashless technology. This approach could also support a more sophisticated and responsive methodology to manage demand on the transport networks through nudging travel behaviour.

3.3 Lisbon

The Lisbon Metropolitan Area (Área Metropolitana de Lisboa AML) has 3 million inhabitants with 5 million person-trips each day. Of these, the majority are estimated to be made by car (56%) and public transport modal share only amounts for a quarter of the trips. There is a significant movement of commuters towards the city of Lisbon, which lies at the geographical centre of the metropolitan area and is its main commercial, business, and administrative hub. 370.000 cars are estimated to enter the city on a typical day (for reference, the city has approximately 500.000 inhabitants). This creates significant pressure on the road network, leading to congestion, and brings relevant impacts to the city, notably in terms of urban space management (e.g., parking capacity is scarce), environmental aspects (e.g., noise, air pollution), and other social aspects (e.g., road safety).

Accordingly, the city of Lisbon is committed to rebalancing its modal split. Whilst passenger cars account for 46% of trips per day (a share that is already lower than the average for the wider metropolitan area), the objective is to reduce this number to 34% by 2030, which would imply shifting approximately 150.000 people per day from their cars into sustainable modes (i.e., cycling, walking and other micromobility modes, public transport). To achieve this goal, Lisbon is foreseeing an investment in more attractive public transport, (e.g., through the renewal of bus fleets or the expansion of metro and tram networks), and more accessible public transport offers (e.g., offering free access to people older than 65 y/o and students up until the age of 23 y/o, increasing the offer of cycling infrastructure, etc.)

However, it is also clear that addressing the challenges posed by traffic and mobility in the city of Lisbon implies a wider perspective that considers the whole of AML. This is where the TANGENT project can contribute to the achievement of these objectives. The metropolis of Lisbon has a large deployment of big network devices and Connected Intelligent Transport Systems (C-ITS) infrastructure on the main motorways accessing Lisbon city namely CRIL (also denominated IC17 or A36), IC19 (also denominated A37), N6 (also denominated Marginal), A1, A2, A5, CREL (also denominated IC18 or A9), and A12. There are also traffic counters and classifiers, variable message panels, speed, and lane control sign information, for exchanging data with the transport network. This information is of paramount importance to optimize the functioning of the mobility system and provide incentives to shift to more sustainable modes of transport.

3.3.1 National planning framework

The Portugal Strategy 2030 (Government of Portugal, 2021) establishes a medium-term path for the economic, social, and environmental development of the country within a decade, advocating options

to overcome the set of structural blockages that have faced the country and that, in many cases, were deepened by the pandemic crisis. For the transport sector, the goals considered are as follows:

- To optimise the management and networked provision of existing collective services in the areas of education, sport, health, culture, social and economic and associative nature, ensuring adequate levels of provision of public goods and services and access to digital networks, enhancing rural-urban links.
- Strengthen the role of the social economy in managing the network of collective services.

Regarding the promotion of sustainable mobility, the interventions aim to accelerate the paradigm shift in this sector, towards its decarbonisation, with traditional fossil fuels being progressively replaced by electricity, advanced biofuels, or other energy carriers of renewable origin, such as hydrogen, and the continued commitment to public transport, changing the mobility patterns of the Portuguese. They involve the reinforcement of the mobility system in public transport in the national territory, with the guarantee of more efficient, attractive, and environmentally sustainable collective public transport offers, with special incidence in urban areas of greater population density, without neglecting flexible functions and adapting to low densified interior territories, besides also having to respond to new demands in terms of public health, as became evident during the pandemic. The promotion of the decarbonisation of the transport sector should be boosted by procuring a fleet and encouraging the introduction of clean energy along with the promotion of multimodal, active, and sustainable mobility by taking advantage of innovative and intelligent transport solutions and fostering efficient shared, flexible, connected mobility patterns, and improving the mobility planning to contribute to low-carbon strategies and spatial planning and the development of monitoring tools.

3.3.2 Local planning framework

The Municipality of Lisbon is striving for a city with a people-centred mobility ecosystem that is accessible, useful, reliable, and safe, based on an integrated public transport network complemented by innovative solutions that allow conscious and sustainable choices. *MOVE Lisbon*, the strategic vision for mobility for 2030 (Cámara Municipal de Lisboa, 2020), aims to provide coherence, by defining a clear plan for the desired future and pointing out the guidelines for the use of operational instruments that will take us to a new level in terms of mobility and urban accessibility. This vision proposes a transport system which is more integrated, reliable, connected, accessible, and open to new solutions,

life of the city and Lisbon Metropolitan Area (AML) residents, and improving the experience of those who use and live Lisbon.

On one hand, the municipality is leading the movement of assumption of the new paradigm of mobility in its territory, on the other, it seeks to influence several partners and integrate them into its action. Acting directly with the Government of the Republic of Portugal, the Lisbon Metropolitan Area, other Municipalities, transport operators and mobility services companies, the Lisbon City Council works to promote solutions that allow for reducing dependence on private cars, creating alternatives that help to foster a rational modal shift, to improve mobility and to increase accessibility.

The *MOVE LISBON* Strategic Vision for Mobility 2030 presents a proposal for future mobility in the city, pointing out guidelines for operational success, namely the reinforcement and/or evolution of 5 transport networks - Pedestrian, Public transport, Road, Cycle, and Interfaces alongside 5 services - like Parking, Shared services, Urban logistics, Additional mobility, and Tourist transport.

The city of Lisbon aims to plan and implement the following as a part of its mobility strategy:

- Increases the attractiveness of public transport (PT);
- Integrates new mobility services into the transport system;
- Restricts private car access to downtown and surrounding hills and implements measures to promote safety in the mobility system, structured through the municipal road safety plan;

- Implements a strategy to accelerate the adoption of electric mobility;
- Requalifies public space and pedestrian network;
- Improves mobility to and from school;
- Expands the cycle lanes network, making it more comprehensive;
- Increases the resident population;
- Promotes the use of the Tagus River as an infrastructure for waterway mobility;
- Continuing the development of Park & Ride infrastructures near peripheral PT interfaces, with tariff integration;
- Finding new employment poles in the PT interfaces surroundings;
- Taking on new forms of work;
- Defends the urgency of metropolitan investment in heavy mobility;
- Strengthens coordination at the metropolitan level of mobility systems.

The successful implementation of the Lisbon mobility strategic vision also depends on the development of legal, institutional, and regulatory mechanisms to ensure the effective implementation of measures defined to improve the transport system. MOVE Lisbon proposes to create or revise regulations that promote the sustainability and effectiveness of the transport system in terms of:

- Parking and circulation on public roads;
- Tourist transport services;
- Taxi services;
- Shared mobility services;
- Whenever safeguarding the public space and security of vulnerable users is justified;
- Electric mobility.

3.3.3 Network Traffic Management

Mobility management presents a particularly interesting potential for a city such as Lisbon, which offers a comprehensive public transport network, and is in the process of investing in infrastructures for active modes and launching high-impact shared services. The definition of assertive management measures can make a decisive contribution to the success of these new investments, enhancing the use of infrastructures and maximising the chances of their successful integration into city life with low cost/benefit ratios. An integrated operational centre will contribute to traffic management, parking, traffic lights, radars, public transport, interfaces, logistics, and shared services, among others, connecting equipment and vehicles, and providing real-time information. Anyone will be able to know the options that the mobility ecosystem offers at any given time, and they will be able to plan, book, purchase, and access their services in an integrated manner. Those who come from the outside will be able to know where the different parking lots are located, their availability, and the possible connections to the multimodal network, boosting their daily use.

To achieve effective management of mobility and the mobility system, which leads to increased efficiency, safety, and comfort of travel in various modes, Lisbon assumes itself as a smart city, with a Lisbon Intelligent Management Platform (PGIL), an integrative structure that collects and processes data, based on the latest technologies and the best analysis, management, and control algorithms. Lisbon also assumes itself as a dynamic innovation ecosystem, packed with entrepreneurs, start-ups,

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Web Summit. Lisbon proposes that the analysis, control, and optimisation of mobility system resources take place in an Integrated Operational Centre (COI) incorporated in PGIL, which concentrates all relevant information for mobility management in Lisbon and, whenever possible, in the Metropolitan Area. The COI will be able to cluster the Operational Mobility Control Centre (CCO-M), where all the

management, control, and monitoring of the mobility system, as follows:

- Integrating processes of all municipal actors, such as the City Council services, the Municipal Police, Carris, and Empresa de Mobilidad e Estacionamento de Lisboa (Lisbon Mobility and parking company EMEL);
- Incorporating data from the mobility system and the respective constraints stemming from municipal services or partner entities management systems, the public traffic lights management system, the speed control radars, the traffic monitoring camera system, the traffic counters, the parking lots, the parking meter network, the limited access areas, the environmental monitoring stations, the urban logistics management systems, the matrix signs, the connected vehicles, the electric vehicle charging stations, among others;
- Analysing the data and generating information that allows optimising the control of mobility in the city continuously, automatically, or manually, managing the traffic constraints, accidents, and incidents, as well as special events;
- Linking with other intelligent control, management, and information systems;
- Ensuring effective real-time operation by managers and decision-makers, and rapid response to events that condition the normal functioning of the mobility system;
- Informing citizens, suggesting the best alternatives, and allowing them to define their mobility options and preferences, enhancing the use of social networks;
- policy;
- Encouraging innovation, providing access to university academia, start-ups, and third parties, tools, and data from municipal services;
- Boosting innovation from projects funded by European and other co-financing funds.

3.3.4 Mobility planning

The whole city will be connected through a network of multimodal axes, where an excellent network of public transport and new mobility services will circulate, using roads and train infrastructures efficiently, and innovatively explore the Tagus River waterway, allowing anyone to have access to urban scale functions (hospitals, universities, service centres, stadiums, among others) with flexibility and freedom of choice. From the coherent definition of the networks and services mentioned above, and from the transversal axes, an accessible Lisbon will emerge, where people, regardless of their physical or economic condition, will be able to move freely and access the goods and services they need. MOVE Lisbon also proposes a set of guidelines to achieve a significant reduction in the use of the private car and, consequently, greater use of public transport and active modes.

The vision for the city of Lisbon for the transport networks and their services includes building up a comprehensive, robust and coherent public transport network in the city integrating new modes and their easy and complete accessibility to the network. It should simultaneously guarantee frequency and fluidity, benefiting from its space channel and traffic light priority at the intersections, guaranteeing quality in the mobility of its residents and visitors, as well as students and workers who enter the city every day. The pedestrian network of Lisbon should be universally accessed by foot both within the neighbourhoods and in the main axes of access to the central areas and infrastructures, in particular, the interfaces and the school network. MOVE Lisbon proposes a road network that increases the importance and fluidity of the circular axes of the city and reduces the importance of the radial axes, protecting the centre through increasingly restrictive crown areas. The network of interfaces allows the connection in PT of any two points of the city with maximum speed and the minimum of transfers, integrating whenever possible other networks and transport services. It is proposed that by 2030 the -sharing system to be developed in several stages and with a density of stations and bicycles that will maximise the potential for use of this mode. Lisbon also proposed to be a cycling city with an urban network that allows the daily use of the bicycle in the home

to work/school trips and leisure travel. Some other functionalities of mobility planning proposed and to be implemented by Lisbon are as follows:

- **C-ITS**:
  adjusting the supply for residents, visitors, and operators of urban logistics in every part of the city. This policy must be supported by an intelligent information system, which guarantees a high quality of service to the users, as well as a better operational management capacity.
- **MaaS**: Integration of new mobility services into the transport system by creating conditions for the existence of integrated platforms of mobility services, in a logic of mobility as a service, ensuring information to the public, simplicity in the acquisition of services and improving its quality and efficiency. It will increase multimodality by adding flexibility and coverage to the transport system.
- **Innovative mobility services**: To make Lisbon a pioneering and testing city for innovative mobility solutions in real but controlled environments, generating a positive impact both on the economy and users. Encouraging the adoption of new mobility models and concepts that promote resource sharing, including innovative solutions regarding shared vehicles, travel, parking spaces, etc., supported by new information and communication technologies, allowing for flexibility in regulation for greater consolidation of innovative solutions.
- **Key Performance Indicators**: Public management processes with direct implications on that aggregate and process data and information, producing a set of key indicators to support decision-making. Monitoring can be used to evaluate processes and define changes that allow for the continuous improvement of the mobility system, better mobility efficiency and increased user satisfaction. To accomplish the strategy, a third-generation Sustainable Urban Mobility Plan (PMUS Portuguese acronym) will be implemented in the city of Lisbon. Monitoring, assessment, and review of the mobility system will be carried out based on the management and control systems as well as on participated mobility observatory platforms, with a set of indicators of public access. These processes will allow:
  - To define indicators that might not only inform the population about the syste performance, but also evaluate and, if necessary, correct the actions developed.
  - To continuously monitor the mobility system, detecting and correcting problems and failures in real-time.
  - To assess the measures and actions implemented as well as the new systems and services, reviewing the options taken, making adjustments, eliminating inconsistencies, and continuously improving the entire mobility system.

The following figures (6 & 7) give an illustration of the goals for Lisbon in their National Programme of Investments 2030 associated with their mobility strategy.

Figure 6. Management and control centres for Intelligent transport system (National Programme of Investments, 2030, Lisbon, 2021).

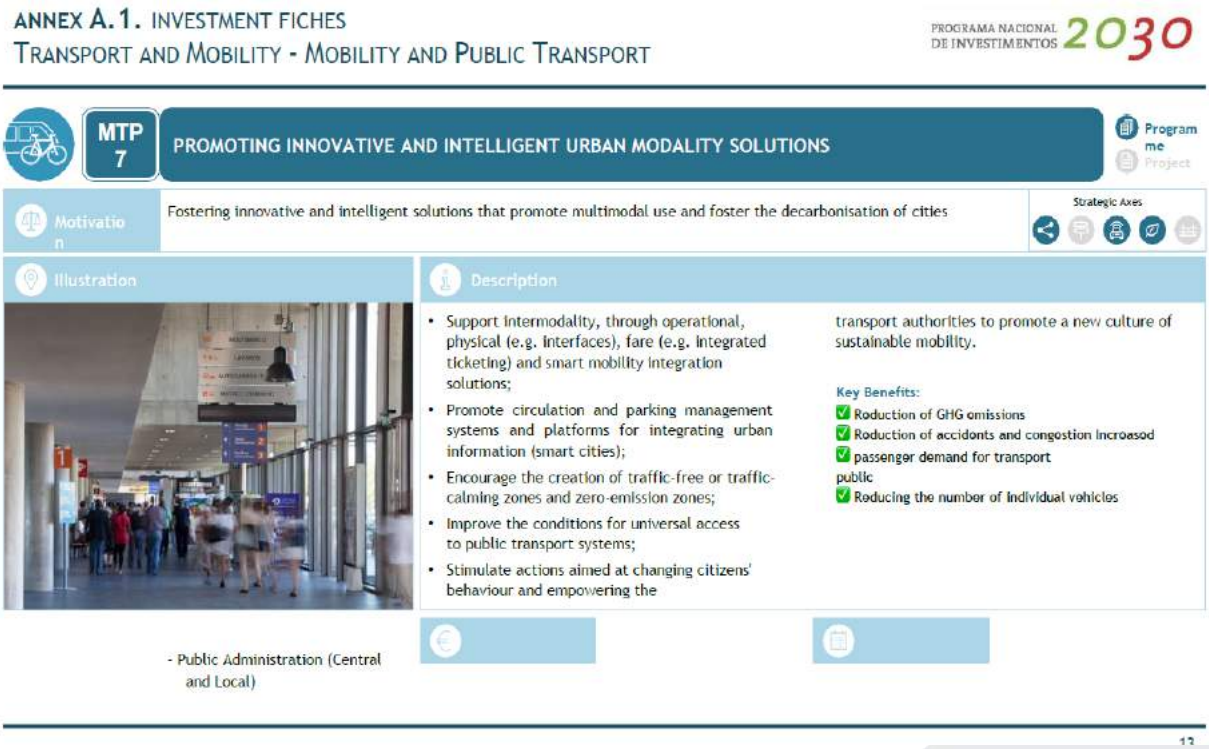

Figure 7. Steps for multimodal use and fostering decarbonization of cities (National Programme of Investments, 2030, Lisbon, 2021).

3.4 Athens

Athens, Greece, is one of the largest economic hubs in Southern Europe, with more than 3 million residents across ~39 sq.km. Athens faces severe congestion problems due to the rising demand for car

to relieve the city centre from increased levels of car traffic and make room for alternative and more

and soft modes, create 2,000 motorcycle parking spots and 12 taxi stands, and facilitate bus services. The transport network of Athens is characterised by 170 public transport lines, 95 bus lines, 14 trolley lines, 4 metro lines, 2 tram lines, 5 suburban lines, 50 intercity bus lines, 1.030 public transport stations, as well as cars, motorcycles, and freight vehicles.

Problems that Athens faces include severe congestion, lack of coordination between different modes, pollution, accidents, and an overrepresentation of private vehicles in commuting patterns. The key mobility priorities for the city of Athens are the improvement of network connectivity and operation, reduction in emissions, accidents, and congestion, and prioritisation of public transport and soft modes.

Mobility services that will be of interest to Athens include first and last-mile services operating alongside the existing public transport network, on-demand vehicles serving less dense areas within the Athens Metropolitan Area and CAVs operating on dedicated lanes or alongside traffic, as they mature technologically.

more advanced management strategies for the demand to be served efficiently. TANGENT will provide strategies to improve network connectivity and operation through a better information system that connects all modes.

3.4.1 Planning framework

Athens is served by several different public transport modes: buses and trolley buses, metro, tram, and suburban rail, which are run by different operators. An extensive bus and trolley bus network, consisting of about 260 bus routes and 19 trolley bus routes, operates in the city of Athens covering most of the Athens metropolitan area. Buses and trolleybuses in Athens are mainly operated by OSY, a subsidiary of the state-owned Athens Mass Transit System (OASA S.A.). The latter also acts as the Transport Authority for the city of Athens, being responsible for the strategic and operational planning, coordination and control of the public transport carried out by public transport means in the Attica Region.

In the action plan of OASA S.A. (Athens Public Transport Authority, 2020), special emphasis is placed on the need to create a meeting between Local Authorities and Urban Transport operators, with the main issue being the integration of Municipal Transport into the unified Public Transport System of the Prefecture of Attica and the achievement of interoperability between them. During the year 2020, requests for the Municipal Transport operation and modification of municipal lines operation were submitted to OASA, which were approved by the Board of Directors of OASA by the Municipalities of Ag.Anargyron-Kamaterou, Maroussi, Nikaia-A.I.Renti, Piraeus, Haidario.

The main activities included in the management of the Athens Mass Transit System (OASA) that are worth mentioning and relatable to this deliverable are as follows:

- Transport Planning & Development
- Operational Planning & Development
- Monitoring & Control of Urban Transport System
- Construction & Project Maintenance
- Supervision of the operation of the N.P.S.E.

OASA currently collaborates with more than 25 municipalities of Attica to develop a Sustainable Urban Mobility Plan. The action continues with the formulation of measures and proposals that will promote sustainable modes of transport (walking, cycling) and their combination with urban transport, discouraging the use of private means, so that the State can be led cooperatively to reduce air pollutant emissions and limit the greenhouse effect. The OASA participated in the planning and approved a total of 60 traffic studies and traffic regulations from 25 municipalities. The regulations concern geometric configurations and traffic modifications in the context of studies aimed at improving urban mobility and upgrading the urban environment by creating safe pedestrian corridors, and cycle paths and organising traffic and parking.

3.4.2 Traffic management

The Traffic Management Centre (KDK) of the Attica Region began its operation in July 2004 and since then its operation has been continuous (24 hours a day, 365 days a year). The main objectives of the Centre's operation are:

- The optimisation of traffic conditions and the safety of the main road network through a quick response to incidents, informing drivers of the prevailing traffic conditions and intervening in light signalling,
- The reception processing study and utilization of traffic data received along the main road network, as well as the cooperation with university bodies (Universities, TEI, etc.) for the realization of relevant research,
- The provision of traffic data in "real-time" to third parties to support telematics applications,
- The cooperation with other traffic control centres (Traffic Police, Traffic Control Centre of Attiki Odos, Fire Brigade, EKAB, TRAM, etc.).

Continuous monitoring is used, among other things, in the management of telematics information (Smart Stops, Passenger Screens, mobile app, site) in real-time for extraordinary events (extraordinary modifications, traffic measures affecting the transport work) and for planned events (network changes, planned strikes, stops, etc.) concerning the Road Communications Services (O.SY) and the Central Communications Services (STA.SY) and general transport issues (fares, etc.). The main objective for 2021 is to provide passengers with accurate information at an even higher level with continuity and consistency, on the one hand, passengers are provided with information under the given reference framework of the telematics system in operation and, on the other hand, that all the requirements for monitoring and supervision of the transport work carried out are met. In addition, new reports will be designed to analyse the traffic data of the leased vehicles in the context of the monitoring of the relevant service contracts.

OASA continuously collects and processes the production and service usage data of the Urban Transport System, to optimize the transport planning and coordination of the transport work performed by the ground and underground public transport in Athens, always in relation to the objectives set in the N.P.S.E.

3.4.3 Mobility planning

The New Strategic Transport Plan of Attica was launched in 2021 (Athens Public Transport Authority, 2020) which comprises their goals of immediate needs for fleet reinforcement to optimize the level of service and redesign the transport system. As a part of their measures and framework, specific actions and interventions were planned by OASA to reach their goals by reorganizing their bus fleet and trolleybuses together with extending their metro line. OASA leased buses to be put into circulation in the region of Attica for the purpose of increasing the frequency of their buses to compensate for the daily trips created in the transport system.

OASA participated in the Electrification Committee, which was established on the initiative of the Ministry of Energy and Environment, to investigate the parameters of the penetration of electrification

in the field of transport. The competent Ministries of Infrastructure and Transport and Energy & Environment were requested to assist and temporarily grant to the OASA Group electric buses, to investigate their operation and to properly plan their integration into the existing fleet and facilities of the OASA Group.

Athens aims to improve its traffic management strategies and make its transport infrastructure more holistic. To have more insights on electrification, micromobility and autonomous vehicles, Athens opted to provide for pilot application in the European project HARMONY, which was executed to support metropolitan authorities, transport operators, and mobility service providers with cutting-edge technology to provide multidimensional impacts to the existing transport policies. Intending to develop, implement and test autonomous traffic management systems with real-time transport system monitoring and simulation models, Athens participated with their pilot in the FRONTIER project to develop a strategic control system for communication between different traffic management centres, promote interoperability across business structures and models and encourage the increase in the share of public transport, improve sustainable mobility and increase network capacity.

Furthermore, further refinement and the synthesis of a model for the regular extraction of Performance Indicators of the Transport Project of OASA and the Passenger Service Level of Athens Urban Transport using Advanced Analytical Data Processing Techniques is under consideration.

4 Sustainable Urban Mobility Planning

4.1 Introduction of the SUMP concept

facto urban transport planning concept. The policy that facilitated its establishment has been systematically developed by European policymakers since 2005. Its most important milestone was the publication of the Urban Mobility Package COM (European Parliament, 2013) (913, article 3), where the European Commission defined in an Annex the concept of Sustainable Urban Mobility Plans. At the same time, the first version of the Guidelines was released. The Urban Mobility Package advocates for a step-change in the approach to urban mobility to ensure

and resource-efficient European transport system are met. It sketches out the guiding principles of the planning process and the topics to be addressed in a Sustainable Urban Mobility Plan.

Since the publication of the Urban Mobility Package, the concept of Sustainable Urban Mobility Plans has been widely taken up across Europe and internationally. An update of the SUMP guidelines was published in 2019, with a review of the SUMP cycle (see figure below) which aimed at providing a step-by-step guide to practitioners in developing a SUMP for their city.

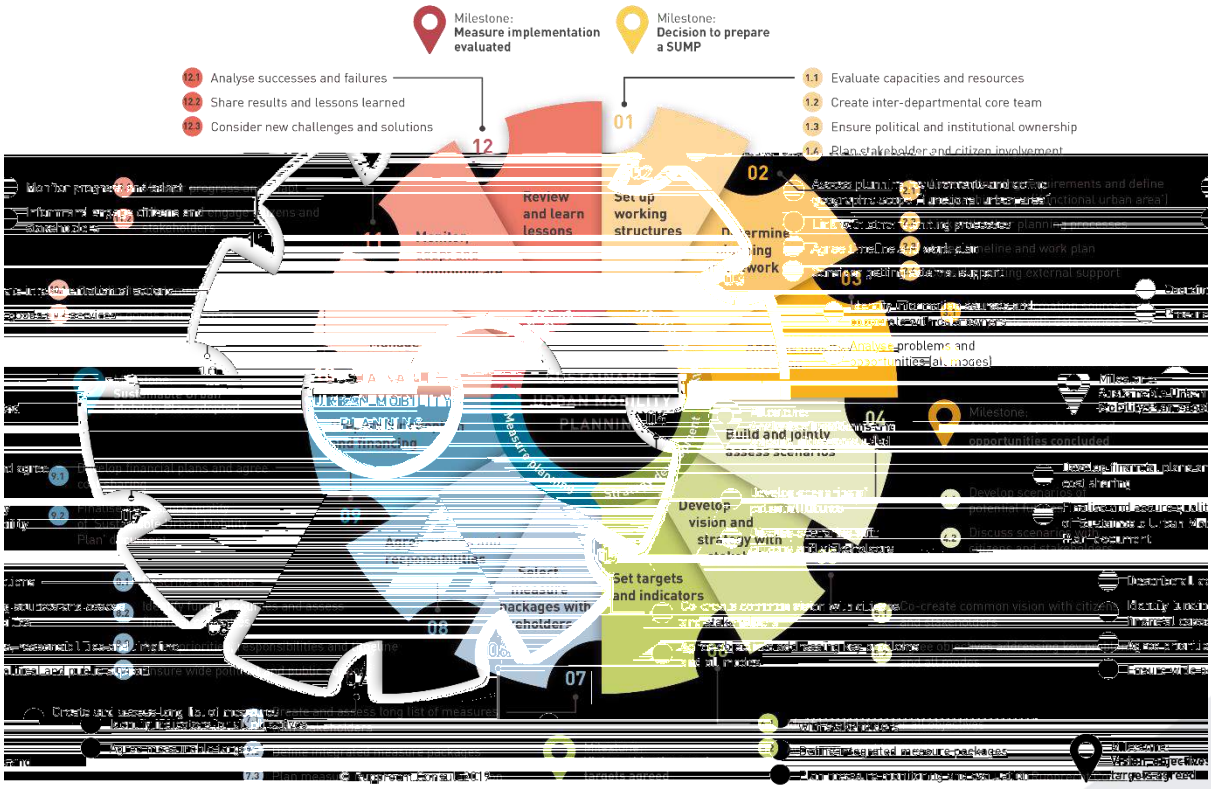

Figure 8. SUMP Cycle (SUMP Guidelines, 2019)

The SUMP will anticipate the problem of many transport master plans, which often define a comprehensive work plan with actions. However, these planned actions are afterwards often ignored, and implementation does not take place. To avoid doing "drawer work", a realistic and implementable programme of measures and defined priorities is needed that considers urgency, impact, public acceptance, and the (limited) human and financial resources. The benefits associated with the existence of a SUMP as evidence shows for worldwide pioneer cities range from making more effective use of limited resources to effectively fulfilling legal obligations and to creating concrete improvements to

the quality of life through more attractive public spaces, improved road safety, improved health condition of citizens and less air and noise pollution.

A SUMP follows a strongly integrated planning approach, which includes not only all modes of transport and purposes, but also other sectoral planning, planning levels, and the urban metropolitan area. Our experience shows that coordinated development of the different sectoral plans and measures for the modes of transport leads to an improvement of the processes in terms of time and content. It is important to include mobility-related policies and plans such as urban development, road space design, and the requirements for family-friendly and barrier-free mobility in the mobility concept.

The SUMP approach has brought significant changes to the transport planning process. In this approach, instead of determining the future structure using the current structure situation and trends, a participatory approach is developed to formulate a vision for the inhabitants to define the city they want to live in, determine the details, and then determine what steps should be taken from today to reach this vision. With a SUMP planning process, instead of predicting the future structure based on the existing structure (prediction; fore-casting), first, the outline of the future structure and the steps to be taken from the current structure to get here are predicted (back-casting). As such, the SUMP approach is much more goal-oriented than traditional transport policy planning methods. Moreover, in the SUMP approach, not only the plan as a document or report prepared by experts but also participation, continuity and keeping the process alive in the process gain priority. A goal-oriented planning process actively designs a sustainable mobility system instead of working purely in a forecast-oriented manner. In contrast to traditional transport planning, the SUMP methodology does not only focus on infrastructural measures but combines them with regulatory measures, incentives and information in cost-effective packages of measures. Essential for the planning process are cross-administrative and cross-political cooperation, meaningful participation of the urban community, and effective monitoring.

Quantifiable objectives and verifiable indicators should be developed that contribute to the setup of an ongoing monitoring system. With effective monitoring and evaluation, the implementation status and the effects of the measures can be continuously checked and, if necessary, readjusted. A performance review can also help to increase the transparency of mobility policies and actions, to make the positive effects of the measures clear to politicians and the public, to de-emotionalise discussion processes, and thus to improve the acceptance of planning. In this way, all aspects and parties involved in the development of a SUMP and/or transport policy will be connected a process called integrated planning. As such, a SUMP will not focus solely on transport, but also on (its relation and/or contribution to) local and regional economic development, land use, social integration etc. This highly integrated planning approach fits the requirements of the mobility of the future, in which different modes of transport are optimally linked and sustainable modes and innovations are promoted. Moreover, preparation along the SUMP standard offers advantages in terms of acquiring funding for actions later on in the process. Sustainable Urban Mobility Planning is an essential element of the official European Union climate policy and is advocated by all European and many national institutions and banks. If a city has a SUMP, it already has a competitive advantage for better access to funding (e.g., EU Structural and Investment Funds, Horizon 2020-CIVITAS, Connecting Europe Facility). This mechanism is expected to increase in the coming years.

4.2 Planning and regulatory framework of SUMP

4.2.1 European scale

The transport sector in Europe has several social, economic, and environmental implications. In recent months, pressure on national member state governments and also on the EU to reduce global warming has made the latter a priority. In 2017, 27% of total EU-28 greenhouse gas (GHG) emissions came from the transport sector, with road transport being accountably responsible for approximately 72% of these emissions. Of these emissions, 44% were from passenger cars, 9 % from light commercial vehicles (LCVs) and 19% came from heavy goods
White Paper for Transport (European Commission, 2011), is to reduce greenhouse gas emissions from transport by 60% (relative to 1990) by 2050. However, data shows that instead of decreasing, emissions

from transportation have increased. In 2017, CO2 emissions from transport increased by 2.2% compared with 2016 (European Environment Agency, 2022). Moreover, road passenger transport is expected to grow by 16% during 2010-2030 and 30% during 2010-2050, while road freight transport will increase by 33% by 2030 and 55% by 2050 (European Commission, 2020). For this alarming trend to be reversed, bold and cohesive actions are needed.

The European Green Deal (European Commission, 2019), recently released by the European Commission (EC), aims at making Europe the first climate-neutral continent by 2050. For it to succeed, it must be corroborated by ambitious and concrete action plans with well-defined targets and integrated with other policies at the national and local levels. European cities host 72% of the EU population and generate over 80% of the EU GDP. It is estimated that 84% of people in Europe will live in urban areas by 2050 (European Commission, 2020). In urban areas, about 25% of CO2 emissions produced are attributable to the transport sector, as well as 30-50% of other transport-related pollutants, like particulate matter (PM) and Nitrogen Oxide (NOx) (ALICE/ERTRAC Urban Mobility WG, 2014). Congestion causes inefficiencies, which lead to producing losses of around 80 billion euros per year.

European cities are facing daunting problems in meeting air quality legal standards (European Environmental Agency, 2018). The success of the policies and political objectives agreed upon at the EU level, such as on the efficiency of the EU transport system, on socio-economic objectives, on energy dependence or climate change in line with the provisions of the Green Deal, depends on the actions taken by national, regional, and local authorities. Mobility in urban areas is also an important facilitator for growth and jobs and sustainable urban development. By implementing regulations and incentives for low-emission alternative energies and vehicles and by encouraging active travel (cycling and walking), public transport and sharing schemes, cities and regions play a crucial role to reduce congestion and pollution in urban areas (European Commission, 2016). The European Union is investing a considerable number of resources in sustainable and smart urban mobility. For the 2014-2020 period, it i a modal shift towards metro and tramways, cycle paths, and intelligent transport systems. However, according to a new report from the European Court of Auditors (ECA) (European Union, 2020), there has been no significant reduction in private car usage, and air pollution in many cities still exceeds safety levels.

The 2011 White Paper on Transport identifies the need to take additional steps to ensure that cities contribute to reducing Europe s dependence on imported oil and cutting carbon emissions in transport by 60% by 2050, achieving essentially CO2-free city logistics in major urban centres by 2030, approaching the target zero victims in road transport by 2050. During the last two decades, the European Commission has developed a growing awareness with respect to the challenges of the urban transport sector[3] , and, consequently, has started defining specific policies and developing dedicated tools to tackle them. Transport is a shared responsibility between the EU and the Member States where the subsidiarity principle[4] applies. Urban mobility is essentially a local responsibility. This potentially hinders the elaboration of common solutions between cities, which might conveniently be tailored to different urban contexts, and produces a single market fragmentation risk when it comes to Intelligent Transport Systems (ITS), access regulations, and discriminatory practices. For this reason, European guidance, research, innovation, good practice exchange, and capacity-building activities represent

[3] The first European policy proposals in the area of urban mobility, the Citizens' Network, date back to 1995 and 1998. In 2001, the 1st White Paper on Transport was released.

[4] Its legal b
areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at

effective means in the hands of the EC and Member States to support the success and coordination of local policies and measures.

To facilitate the adoption of a more shared approach, the EC encourages cities to develop a long-term vision and objectives for urban mobility. In 2013 it released the Urban Mobility Package (UMP) Together towards competitive and resource-efficient urban mobility (European Commission, 2013), providing an overview of possible actions, including guidelines on Sustainable Urban Mobility Plans (SUMPs), released for the first time in 2013 and updated in 2019 (Rupprecht Consult, 2019), and working documents on access regulations, urban logistics, urban road safety and urban ITS. The central Communication, stressing the importance of the coordination between the public and private sector, claims the coordinated deployment of urban ITS and the importance of urban nodes, considered the -
European transport (TEN- -T guidelines (2013), revised in 2021 (European Commission, 2022). It also defined the future scope of action of the EU-funded CIVITAS
conventionally-fuelled vehicles in urban areas, reducing transport impacts and costs, and strengthening

represent an innovative approach to city planning, fostering effective, coordinated and consistent initiatives - local authorities have to define long-term objectives - and ensure their achievement within a sustainable framework - the type of corrective action shall be defined through a long-term planning process that takes into account the principles of participation, evaluation and integration.

-T Regulation would strengthen infrastructure requirements in view of achieving more efficient and sustainable transport services and shifting passengers and freight towards more sustainable modes of transport. To this end, the revised Regulation calls for more transhipment terminals, improved handling capacity at freight terminals, reduced waiting times at rail border crossings, and longer trains to shift more freight onto cleaner transport modes. All 430 major cities along the TEN-T network will have to develop Sustainable Urban Mobility Plans to promote zero-emission mobility, and to increase and improve public transport. Provisions to make the TEN-T more resilient to the effects of climate change are also included. The Commission proposal reinforces the governance of TEN-T to assure the timely completion of the network by 2030 for the core network, 2040 for the extended core network, and 2050 for the wider, comprehensive network. In the context of TANGENT, Lisbon, Rennes and Athens are part of the urban nodes network having to develop SUMPs to promote zero-emissions mobility.

4.2.2 National scale

Greece has passed a law (4784/2021) in 2021 to create an institutional framework favouring the development of SUMPs and encourage local communities to use SUMPs as the main lever for upgrading the urban environment**.** The Greek government took a step forward and not only institutionalised SUMPs but also made them mandatory for cities with a population of more than 30,000 inhabitants.

In France, the obligation to draw up a PDU (similar to a SUMP) is defined by law (Article L1214-3 of the transport code) making it mandatory to establish mobility plans in the territorial jurisdictions of the mobility organizing authorities included in the agglomerations of more than 100,000 inhabitants. This is also mentioned in Article L.221-2 of the Environmental Code. PDUs have been first introduced in 1982 but their compulsory character dates back to 1996 (CEREMA,2020). Since 2021, PDUs have been replaced by the Plan de Mobilité (PdM), implemented by the *Loi d'orientations des mobilités* (LOM) (Law on the orientation of mobilities) n2019-1428.

In Portugal, there is no formal legal obligation for local authorities to implement a SUMP. In 2011 the Institute for Transport and Mobility (IMT), developed a national strategy for the approach of accessibility, transport, and mobility, and their relationship with land use planning, which included:

- National Directives for Mobility setting the national strategy for mobility and the appropriate instruments to put in place;

- Guide for the development of Mobility and Transport;
- Technical and Thematic brochures on sustainable mobility and SUMP;
- Guidance on accessibility, mobility and transport issues in land use planning instruments at the municipal level.

The National Directives were proposed to be adopted as a Ministers Council Resolution in 2012, making SUMP mandatory for municipalities with over 50 000 inhabitants or for district capitals, and voluntary in others. The Transport Metropolitan Authorities of Lisbon is legally obliged to prepare a SUMP.

In the United Kingdom, Strategic transport authorities are expected to prepare local transport plans since the Transport Act 2000. They can be subject to a strategic environmental assessment that is undertaken following UK regulations that are based on EU regulations. A recent policy paper sets out , 2019).

4.3 Key aspects of the process relevant to NTM solutions and multi-actor cooperation models

The SUMP process offers a key framework to develop mobility solutions through integrated planning, which offers certain opportunities for local practitioners and decision-makers to improve the network traffic management solutions and encourage multi-actor cooperation.

4.3.1 SUMP & Intelligent Transport Systems

SUMP can provide a framework to further develop ITS in cities, allowing the development of all transport modes in an integrated manner using smart technologies and ITS as tools and basic infrastructure to achieve integrated development of transport modes with an important role in the management of infrastructure and transport subsystems operations in a city. The key application of ITS on traffic management is supporting in practice the development of multimodal transportation in an integrated manner.

Integrating SUMP and ITS can also further promote cooperation across institutional boundaries, as many IT, like traffic management, require coordination across institutional boundaries at the city and regional levels but also among local municipalities. At the regional level, the detailed ITS design and operation are made by private and public stakeholders on a transport network that includes multiple municipalities and service providers. At the
or sustainability objectives are formulated demanding customised operations (i.e. C-ITS services for priority of buses at signal intersections) or radical changes (i.e. reducing traffic in the city centre or supporting Low Traffic Zone implementation). SUMP processes can take advantage of the existence of integrated ITS in urban areas as they often create the basis for multi-stakeholders common understanding and cooperation.

4.3.2 MaaS

Developing a SUMP can help cities further enable the development of Mobility as a Service (MaaS), but the reverse also stands as information from MaaS services can supply key data for urban traffic and travel information, as well as traffic management. MaaS often reaches out beyond a single urban area and therefore collaboration among other institutional bodies at the regional and sometimes national levels is necessary. Early engagement with all relevant administrative departments is particularly relevant when identifying how MaaS data (and often location-
preferences and behaviour) could be used to support traffic management and city planning. Collaboration with other bodies, at regional but also at national and European levels, is also important to establish technical interoperability frameworks.

Adopting MaaS measures as part of the SUMP process will institute a new stage in traffic management within the city, where traffic optimization can come from different sources, one being mobility service

providers, and used to enable some advanced services to the end-users. In the case of MaaS, the traffic management operators would have access to dynamic traffic data but also collect essential information, enabling them to provide traffic data services related to forecasting travel time estimation, level of services, etc. However, MaaS is not just an additional information channel for users, and traffic management is not just another source of mobility information. Integration between MaaS and traffic management is essential to increase the efficiency of urban mobility, overall the state of the traffic, and the quality of services delivered to users. An improved service of sustainable modes would further promote the use of these services among citizens.

Policy, regulation, and legislation that enable and support MaaS are key to its successful implementation and to ensure its further integration with traffic management.

5 Pathway towards a Network Traffic Management planning framework

5.1 Analysis of key factors, challenges and requirements identified

The analysis of regulatory and planning frameworks, across governance levels, applicable to TANGENT reviewed research experience and literature on the topic, illustrate the importance of clear and comprehensive regulatory and planning frameworks for the successful implementation of Network Traffic Management solutions.

Moreover, the analysis highlights key challenges and gaps in current norms which should be addressed to enable the effective deployment of NTM services.

Common strategic framework - At the local and regional level, goals to enhance the sustainability and multimodality of the transport system by strengthening public transport and achieving complementarity and integration among the different transport modes require a high level of cooperation between the involved actors. And even more so, this is true for the deployment of cooperative traffic management through real-time decision-making and optimisation of the network. The directives defined in applicable policy and mobility planning strategies can be essential to facilitate the coordination of such multi-actor cooperation, by defining common objectives and principles to guide decision-making and resolve conflicts among actors. Besides, the governance structures, as well as communication and engagement channels for cross-sectorial cooperation set a basis for NTM service implementation.

Stakeholders landscape – as described, different aspects of NTM involve a wide range of actors and its implementation requires close collaboration among them. In this context, the spectrum of parties involved in the process is particularly complex. Authorities (especially in the field of traffic control operations), procurement, maintenance, operation of the service, external advisors, infrastructure, vehicle manufacturers, national and European legislators or even financial services (in case of tolling). Each service area imposes certain requirements to interconnect with other service areas, and this impacts the collaboration requirement. Besides, the need for to cover the functional urban area, often going beyond administrative boundaries, and to enable cooperative action involving neighbouring municipalities and the region, highlights the importance of a wide-ranging planning framework including all relevant actors and authorities, within and beyond the administrative boundaries.

Interoperability - Moreover, NTM involves the interconnection of services from the entire spectrum of the transport ecosystem. For each of those subsystems, the essential requirements need to be specified and the technical compatibility must be determined and ensured. Interoperability is essential to ensure effectiveness for NTM which becomes especially relevant considering growing interactions among different technologies and transport modes. Cross-modal challenges have been overcome between some transport modes, however, in other cases remain a major obstacle to the large-scale application of NTM, which could be solved through a clear and comprehensive regulatory and planning framework of NTMs.

Human factor – in all transport-related challenges, humans remain the biggest variable. Imbalance and possibly resulting conflicts between needs, preferences, constraints and supply of transportation, remain critical to resolving. Human is also the most unpredictable and mistake-prone element of the transport system. In consequence, human is the most likely to disrupt the network yet is the least feasible to estimate their behaviour upfront with high certainty. Furthermore, accessibility issues for physically unpaired people should be considered. As people differ on the individual level (e.g., personality), there are also significant differences in the level of cognitive capacity, decision-making abilities, attention level, risk perception, psychological constructs etc. (Millonig & Haustein, 2020). Regulation and action planning for NTM implementation must therefore account for all these differences and properly accommodate their possible consequences.

Harmonised regulatory and legal frameworks – A need for a European framework for the regulation of disruptive innovations related to mobility has been evidenced by previous research and experiences

target the harmonisation of standards and requirements for testing mobility innovations (including services, technologies, platforms and infrastructure), addressing key aspects such as safety, data management, service level and security, among others. A common policy agenda and relevant regulatory directives are also key to guiding the assessment of impacts from the tested mobility innovations (at economic, environmental, social and organisational levels), as well as the exchange and transfer of findings and lessons learned. Current efforts on the national level to test services such as AV services and their integration with public transport require harmonised regulations at the international level for a standardised rollout of the technology, complying, for example, with road safety and signalisation standards across countries.

At the national and international levels, harmonised and holistic legal frameworks are vital supporting factors for NTM implementation in urban and regional environments. Data management normative enables the definition of clear data regulation and enforcement at the local level. Also, the definition of conditions for service testing (through pilots and living labs) of innovative technologies and mobility solutions is very important. The development of cooperative traffic management services needs to have a legal framework to solve the upcoming liability issues (data ownership and reliability).

The norms on data sharing and management can also significantly impact NTM, defining standards and sharing requirements, ensuring privacy protection and security, and in general providing the conditions for stakeholders and users to safely and confidently interact and exploit the benefits of information exchange. The safety and security of all technical and operational functions of Network Traffic Management systems cannot be compromised. Regardless of the evolution in the domain, these aspects will hold an integral place and remain critical within an NTM system (Southwest Research Institute, 2019). Since NTM are using data considered as personal (e.g., generated via detecting sensors, connected vehicles communication etc.), it is subjected to GDPR (European regulation on the processing of such data), which has major implications on security aspects of the architecture.

The positive outcome of NTM is determined to a large extent by the provision of high-quality, interoperable data. Firstly, in order to create NTM, data must be shared between different stakeholders, which currently is still a difficult element of discussion between stakeholders. The interoperability of data, especially between different transport modes, creates another challenge. Currently, there exists high granularity in terms of data formats and content which might require a change in practices among some of the key players. A key data-related issue remains data processing in the light of GDPR. The lack of data interoperability issue must be addressed to exploit properly the data and exchange them with the stakeholders (service providers, traffic management centres and end-users). As identified by his governance of data is of key importance and rather urgent to avoid self-governance. Moreover, data sharing and access to data are big questions, treated differently across EU Member States. These raise significant sensitivities amongst transport operators, both in terms of impact on their business of opening such data and in terms of costs associated with the data gathering and compatible data formats . The discussions with local actors at each TANGENT site on data governance constitute a valuable experience towards this goal.

Furthermore, support from national and international levels also has vital importance in relation to the allocation of resources and guidance towards the harmonisation of research efforts. Funding service testing and implementation, through a clear planning and policy framework at the EU/national level, is a key factor for the further development of NTM solutions, as well as expert guidance and capacity-building activities for local planners and operators.

5.2 Next steps

Task 1.4 will continue to monitor and analyse new developments on applicable regulatory and planning frameworks for NTM. Including the revision of the ITS directive, announced in 2020, and some of its

initiatives are mentioned as a part of the Sustainable and Smart Mobility Strategy of UE. Among expected changes are common data spaces for mobility, eCall framework and two revisions of delegated regulations (specifically important for TANGENT) - on real-time traffic information (to extend its geographical coverage) and on multimodal travel information system (to include mandatory accessibility of new dynamic data sets). The large-scale deployment of intelligent and interoperable traffic management solutions like NTM has been acknowledged as the key to maximizing the infrastructure capacity and reducing negative externalities of road transportation. TRIMIS indicated 6 European Technology Platforms that can enable further opportunities and are specifically applicable to NTS: The Single European Sky Air Traffic Management Research (SESAR); The advanced signalling and Rail Traffic Management System (ERTMS); The Safe and Secure Maritime Traffic Monitoring and Information System (SafeSeaNet); The Real-Time River Traffic Information System (RIS); The Cooperative Intelligent Transport Systems (C-ITS); Galileo (The European Global Navigation Satellite System).

The analysis of a baseline for the strategic discussions and actions in the preparation and implementation of each case study (WP7), as well as the assessment of its results and subsequent identification of lessons learned and policy recommendations (WP8).

The challenges and requirements identified in this document for planning and regulatory frameworks for NTM services, together with the assessment of applicable context at each site, will serve as guiding elements for the case studies preparation and deployment. The policy goals and strategic objectives for future mobility at each case study site, as well as the limitations and conditions set by applicable regulations, provide the framework for the case studies (e.g., scope, KPIs).

Following this initial analysis, Task 1.4 will continue to support and monitor the local planning and . The results and findings from this process will be collected and analysed towards the development of the

6 Conclusions

This deliverable, being a first release of the D1.7, mainly provided a preliminary analysis of the planning and regulatory framework in each TANGENT city, as well as at national and EU levels, towards the effective integration of Network Traffic Management solutions and multi-actor cooperation models in local sustainable urban mobility planning processes.

It provided some background information and review key discussions taking place around NTMs in Europe, namely by gathering insights and lessons learned from various European research and innovation projects on NTM. It also presented an overview of the SUMP concept as a planning tool and how it can enable an integrated approach towards NTMs innovative solutions implementation.

The second version of TANGENT
(D1.6) will follow this initial analysis and incorporate results and findings from the local planning monitoring and implementation process of TANGENT services in each case study.

7 References

ALICE/ERTRAC Urban Mobility WG. (2014). *Urban Freight research roadmap*. https://www.ertrac.org/uploads/documentsearch/id36/ERTRAC_Alice_Urban_Freight.pdf

Athens Public Transport Authori

Bourée, K., De Vries, B., Duquesne, C., Dodson, C., Jugelt, S., Martirano, G., Minghini, M., Pignatelli, F., INSPIRE-MMTIS: overlap in standards related to the Delegated Regulation (EU) 2017/1926, EUR 29975 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-13046-8, doi:10.2760/404745, JRC118744.

Busquet, C., Bousse, Y., Lubello, V., Marinic, G., & Reynaud, A. (2019). *Analysis of regulatory responses and governance models THE FINDINGS OF THE ANALYSIS OF REGULATORY RESPONSES AND GOVERNANCE MODELS*. www.h2020-gecko.eu

CEREMA. (2020). *PDU obligatoires au 1er janvier 2020 | Cerema*. https://www.cerema.fr/fr/actualites/pdu-obligatoires-au-1er-janvier-2020

CH4LLENGES http://www.sump-challenges.eu/

CIVITAS, www.civitas.eu

CoExist, https://www.h2020-coexist.eu/

Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services

Commission Delegated Regulation (EU) 2017/1926 of 31 May 2017 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services

Department for Transport. (2019). *Future of mobility: urban strategy*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/846593/future-of-mobility-strategy.pdf

https://www.eea.europa.eu/highlights/air-pollution-still-too-high

ERTICO ITS Europe (editor), (2019), Mobility as a Service (MaaS) and Sustainable Urban Mobility Planning. https://www.eltis.org/sites/default/files/maas_sump_topic_guide_2021.pdf

Towards a competitive and

https://ec.europa.eu/transport/themes/strategies/2011_white_paper_en

European Com -
COM(2013) 913 final.

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Commission. (2020). *The Future of Road Transport - Implications of automated, connected, low-carbon and shared mobility*. https://joint-research-centre.ec.europa.eu/crosscutting-

activities/facts4eufuture-series-reports-future-europe/future-road-transport-implications-automated-connected-low-carbon-and-shared-mobility_en

European Commission. (2022). *Trans-European Transport Network (TEN-T)*. https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en

European Commission. (2022). *Transport emissions*. https://climate.ec.europa.eu/eu-action/transport-emissions_en

European Court of Auditors. (2020). *Special report 06/2020: Sustainable Urban Mobility in the EU: No substantial improvement is possible without Member States' commitment*. https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=53246

European Environmental Agency. (2018). *Air pollution still too high across Europe — European Environment Agency*. https://www.eea.europa.eu/highlights/air-pollution-still-too-high

European Parliament, & Council of the European Union. (2010). *Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport Text with EEA relevance*. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32010L0040

Flow, http://h2020-flow.eu/

FRONTIER https://www.frontier-project.eu/

GECKO, https://h2020-gecko.eu/

HARMONY, https://harmony-h2020.eu/

Transport for Greater Manchester. (2017). Greater Manchester Transport Strategy 2040. https://assets.ctfassets.net/nv7y93idf4jq/01xbKQQNW0ZYLzYvcj1z7c/4b6804acd572f00d8d728194ef62bb89/Greater_Manchester_Transport_Strategy_2040_final.pdf

MAVEN http://www.maven-its.eu/

Move Lisboa Strategic Vision for Mobility 2030, October 2020 (MOVE LISBOA Visão Estratégica Para

A Mobilidade 2030, Outubro 2020, Câmara Municipal de Lisboa

Multi-Stakeholder partnerships, FRONTIER, http://www.frontier-project.eu/multi-stakeholder-partnerships

ORCHESTRA, https://orchestra2020.eu/

Portugal Strategy 2030, Recovering Portugal, Ministry of Planning, 2021 (Estratégia Portugal 2030,

Recuperar Portugal, Construindo o futuro, 15.fev, 2021)

POSSE, https://trimis.ec.europa.eu/project/promotion-open-specifications-and-standards-europe

Sproni & Athony Mitrano

Rennes Métropole. (2019). *Plan de Déplacements Urbains 2019-2030*. https://metropole.rennes.fr/sites/default/files/file-PolPub/PDU%202019-2030.pdf

Resolução do Conselho de Ministros. (2020). *Diário da República, 1.ª série PRESIDÊNCIA DO CONSELHO DE MINISTROS*. https://portugal2030.pt/wp-content/uploads/2021/11/RCM98_2020.pdf

Rupprecht Consult (editor), Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition, 2019. https://www.eltis.org/sites/default/files/sump_guidelines_2019_interactive_document_1.pdf

Millonig, A., Haustein, S. (2020), Human factors of digitalized mobility forms and services. Eur. Transp. Res. Rev. 12, 46.

Korkmaz H., et al. (2022), User acceptance of autonomous public transport systems: Extended UTAUT2 model, Journal of Public Transportation, Volume 24.

McKinsey Center for Future Mobility (2019), Race 2050 A Vision for the European Automotive Industry.

CCAM Strategic Research and Innovation Agenda (2022), European leadership in safe and sustainable road transport through automation 2021-2027.

Southwest Research Institute (2019), Cybersecurity of Traffic Management System, Transportation Research Board.

Annex I Projects

CH4LLENGE

Project	CH4LLENGE	
Period	2013 March - 2016 March	
Solutions	Four Challenges: Participation, Cooperation, Measure Selection, Monitoring and Evaluation. Each challenge has a kit that includes manual, brochure, e-learning module.	
Pilots sites	Amiens, Brno, Budapest, County of West Yorkshire, Dresden, Ghent, Krakow, Timisoara and Zagreb. 30 Follower Cities	
Actors	**Industry**	
	Science	Urban Planning Institute of the Republic of Slovenia; Politehnica University of Timisoara; ITS Leeds; FGM AMOR; The Association for Urban Transition
	Government	City of Amiens, Brno, Dresden, Ghent, Krakow, Timisoara and Zagreb BKK Centre for Budapest Transport, West Yorkshire Combined Authority
	Other	**Rupprecht Consult (coordinator)**, Union of the Baltic Cities Sustainable Cities Commission, POLIS
Site-specific learnings		
Key learnings	Key tasks in SUMP development **Final Report:** Participation Collaborative planning with stakeholders and citizens Open up for debate Embrace participation Reach-out for transparency Cooperation Get prepared for institutional cooperation Cope with complexity Establish responsibilities Identify your partners Agree on procedures Top skills of a SUMP project manager -p.11 Measure selection Select the most effective policy for your city Follow a rational process Key barriers in measure selection p.15 Monitoring and evaluation Monitoring & evaluation for sustainable urban mobility in Europe Proceed a constant activity Evaluate the planning process and the quality of the SUMP	
Key resources	Final report - http://www.sump-challenges.eu/sites/www.sump-challenges.eu/files/01_ch4llenge_final_report.pdf	

Project	CH4LLENGE
	Outputs - http://www.sump-challenges.eu/content/outputs Kits - http://www.sump-challenges.eu/kits Cooperation Manual SUMP chart - http://www.sump-challenges.eu/sites/www.sump-challenges.eu/files/03_ch4llenge_sump_chart.pdf Pilots: Pilot documentation report - http://www.sump-challenges.eu/sites/www.sump-challenges.eu/files/1_ch4llenge_pilot_documentation.pdf Budapest Mobility Plan - http://www.sump-challenges.eu/sites/www.sump-challenges.eu/files/bmt2016_eng_v3.pdf

CIMEC

Project	CIMEC	
Period	2015 June 2017 May	
Solutions	CCAM project with main solution **Roadmap for city deployment of C-ITS** Project overview: Examines cooperative ITS (C-ITS) from a city authority perspective, rather than C-ITS covers cooperation/communication/data sharing between vehicles (V2V) and between vehicles and infrastructure (V2I). CIMEC is naturally focusing on V2I Focuses on the needs of cities, i.e., why should cities deploy C-ITS and what benefits can it brings to the goals that cities are trying to reach. Cooperation is central to C-ITS because it involves secure two-way messaging being different players in the mobility system. There is a specific section on cooperation in the roadmap A CSA, ie, **no demonstrations**. Lots of stakeholder consultation, especially with public authorities. Some public authorities as partners (Kassel, NPRA and Reading)	
Pilots sites	Bilbao, Kassel, Trondheim, Reading	
Actors	**Industry**	
	Science	**SINTEF (coordinator)**
	Government	City of Kassel, Reading Borough Council, Norwegian Public Roads Administration
	Other	POLIS, Albrecht Consult, Centaur Consulting, MLC ITS Euskadi
Site-specific learnings		
Key learnings		
Key resources	Deliverables - https://cordis.europa.eu/project/id/653637/results **Final roadmap:** This Roadmap takes a broader view. It is intended, above all, to be an overview perspective on how the city C-ITS market is expected to develop in Europe: to provide a vision that European cities can collectively recognise and support, and that other stake planning. http://cimec-project.eu/wp-content/uploads/2017/04/CIMEC-D3.3-Final-Roadmap-v1.2.pdf	

CoExist

Project	CoExist	
Period	2017 May - 2020 April	
Solutions	AV-ready framework for road authorities and supporting the technological development of traffic simulations tools. Context EU-US Twinning Pilot sites follow different use cases.	
Pilots sites	Milton Keynes, Stuttgart, Gothenburg, Helmond	
Actors	**Industry**	TASS International, Groupe Renault
	Science	Stuttgart University, Swedish National Road and Transport Research Institute (VTI), PTV Group, Università Firenze, Forum des Laboratoires Nationaux Europeens de Recherche Routier (FEHRL), Vedecom, ID4CAR
	Government	City of Milton Keynes, City of Stuttgart, City of Gothenburg, City of Helmond
	Other	**Rupprecht Consult (coordinator)**, POLIS
Site-specific learnings		
Key learnings	From *D4.7 Guidelines: How to become an automation-ready road authority?*: **How can local authorities shape CAV deployment in alignment with their policy goals?** • Authorities should look at planning for Cooperative Connected and Automated Mobility (CCAM) as an element of a more fundamental change process: proactive action to get ready for the challenges of conducting planning processes towards CAV deployment. • Planning for CCAM should be based on analyses of all modes and supported by all stakeholders (and not on an SAE perspective). • Transport and infrastructure planning through adequate tools: automation-ready modelling functionalities & impact assessment framework, with strategically defined Key Performance Indicators in relation to local policy goals. • In addition to (old) risks, new opportunities for sustainable urban development arise, which can potentially spur flexibility and create room for experiments.	
Key resources	Research Article in Journal of Advanced Transportation - An Approach for Handling Uncertainties Related to Behaviour and Vehicle Mixes in Traffic Simulation Experiments with Automated Vehicles - https://www.hindawi.com/journals/jat/2020/8850591/ - - https://h2020coexist.wpenginepowered.com/wp-content/uploads/2020/04/05815-POLIS-CoExist-document-05.pdf D4.6 Automation-ready Action Plan for each road authority - https://www.h2020-coexist.eu/wp-content/uploads/2021/02/D4.6_Automation-ready-Action-Plan-for-each-road-authority_vf.pdf D4.7 Guidelines: How to become an automation-ready road authority? - https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5cec245e3&appId=PPGMS More on the "AV-Ready" transport models and road infrastructure (Periodic Reporting for period 2) - https://cordis.europa.eu/project/id/723201/reporting	

DIT4TrAM

Project	DIT4TraM	
Period	2021 September - 2024 September	
Solutions	Swarm Intelligence decentralized bottom-up approach to traffic management Four applications: Cooperative connected traffic management Cooperative distributed traffic management Decentralized demand management Cooperation between transport services	
Pilots sites	Amsterdam, Athens, Barcelona, Bordeaux, Glyfada, Utrecht	
Actors	Industry	Aimsun, D.E.I.A. Ltd, GERTRUDE Same, NeoGLS, Bestmile SA, SIEMENS, Technolution
	Science	**TU Delft (coordinator)**, AMS Amsterdam Institute for advanced metropolitan solutions, Bar-Ilan University, EPFL, ETH Zurich, Université Gustave Eiffel, NTUA - The National Technical University of Athens
	Government	Amsterdam Government, The City of Boredeaux, The City of Glyfada, The City of Utrecht
	Other	Arane, POLIS
Site-specific learnings		
Key learnings		
Key resources		

FlexCurb

Project	FlexCurb	
Period	2022 January December 2022	
Solutions	Tools for planning with better data, offer only the parking needed, minimize double parking and improve street safety and land use Digitized parking rules and regulations Curb information Two digital solutions: FlexCurb Planning Platform FlexCurb Driver App	
Pilots sites	Leuven, Toulouse, Funchal, Strasbourg	
Actors	Industry	
	Science	**CTAG – Automotive Technology Centre of Galicia (coordinator)**, CARNET, Ghent University
	Government	City of Leuven, City of Toulouse, City of Funchal, City of Strasbourg
	Other	Urban Radar (Public service & government agency), FIT Consulting, POLIS
Site-specific learnings		
Key learnings		
Key resources		

FLOW

Project	FLOW	
Period	2015 May 2018 April	
Solutions	Multimodal analysis methodology to assess the impact of walking and cycling measures on transport network performance and congestion Learning & Exchange Context: The first project explicitly linking walking and cycling with congestion reduction.	
Pilots sites	Budapest, Dublin, Gdynia, Lisbon, Munich, Sofia	
Actors	Industry	
	Science	Budapest University of Technology and Economics, PTV Group, TRL - the UK's Transport Research Laboratory, Wuppertal Institute, Gdansk University of Technology
	Government	BKK Centre for Budapest Transport, Dublin City Council, City of Gdynia, City of Lisbon, City of Munich, Sofia Urban mobility Centre
	Other	Rupprecht Consult (coordinator), Walk 21, POLIS, The European Cyclist's Federation, FEHRL, The Federal Highway Research Institute (BASt) of the German Government, Traject - Mobility Management
Site-specific learnings		
Key learnings		
Key resources	Walking, Cycling and Congestion, Implementer's Guide to Using the FLOW Tools for Multimodal Assessments - h2020-flow.eu/fileadmin/user_upload/flow_D_3.5_Implementers_Guide_multimodal_approach_EN.pdf Walking and Cycling: A Multimodal Approach to Congestion Management - FLOW project summary and recommendations - h2020-flow.eu/fileadmin/user_upload/EN_flow_A_Multimodal_Approach.pdf	

FRONTIER

Project	FRONTIER	
Period	2021 May 2024 April	
Solutions	Traffic Management: AI tools, decision support methodologies and tools, Multi-stakeholder Partnerships Data Fusion and stream processing for dynamic traffic management Analytics & Optimisation - Estimation, prediction and optimisation of transport data for future multi-modality	
Pilots sites	Oxfordshire TEN-T Corridor, Athens Attiki Odos Motorway, Antwerp Port	
Actors	**Industry**	Frontier Innovations, MOBY X Software Limited, Aimsun, Netcompany-Intrasoft, Preston EV Limited StreetDrone, TagMaster
	Science	**Fundacio Eurecat (coordinator)**, University of Antwerp, Institute of Communication and Computer Systems (ICCS), University of Wolverhampton, Technical University of Crete

Project	FRONTIER	
	Government	Oxfordshire County Council (OCC), Athens Urban Transport Organization (OASA), Attiko Metro (AMETRO), Attikes Diadromes SA, Flemish Waterways (DVW), Flemish Traffic Center, United Kingdom Atomic Energy Authority
	Other	International Road Federation, IBI Group
Site-specific learnings		
Key learnings		
Key resources	Latest technical publications: Regulatory schemes for CAV-inclusive multimodal traffic management: opportunities, threats, and next steps Risk Assessment of Autonomous Vehicles across Diverse Driving Contexts	

GECKO

Project	GECKO	
Period	2018 December - 2021 August	
Solutions	NMS project. Tools: Knowledge Bank Compliance Map Dashboard Overview: Examined regulatory and governance frameworks against a backdrop of mobility transition Does not deal with NM but mobility more generally especially new mobility service (NMS)	
Pilots sites		
Actors	Industry	
	Science	Luigi Bocconi
	Government	
	Other	UITP (coordinator), Fit Consulting, POLIS, CORTE, Absiskey, Rupprecht Consult
Site-specific learnings		
Key learnings	From D2.3: Three forms of public-private cooperation: MoU Contract Informal information sharing Barriers to cooperation: difference of goals/objectives between the public and private sector; lack of technical competences and understanding on part of the public sector; hidden commercial interests of private sector that lead to a limited trust; false expectations related to the technology created through a lack of understanding or hype; lack of platforms or forums to engage in collaboration	

Project	GECKO
	Data is key to assess new mobility solutions, however the main barriers to sharing data between public and private actors include: the lack of standards; the lack of willingness to share data by the private sector due to business interest; and privacy issues. Other actors to be involved in the cooperation process include: third party authorities; end users; households and non-users; associations and researchers. Solutions to improving cooperation among public and private parties include: platforms that bring together public and private parties; living labs and neutrality commissions to help break silos at a vertical level and at a horizontal level for public-private cooperation; providing legislation and regulation from public authorities; and sharing anonymised data with the private sector for business development. Balance of influence between public authorities and new mobility solution providers is important. Regulation can be fluid in this process.
Key resources	D2.3 Analysis of cooperation models among public and private parties - https://h2020-gecko.eu/fileadmin/user_upload/publications/GECKO_D2.3_Analysis_of_cooperation_models_among_public_and_private_parties.pdf

LEVITATE

Project	LEVITATE	
Period	2018 December 2022 May	
Solutions	Impact assessment framework for policymakers to manage the introduction of connected and automated transport systems, maximise the benefits and utilise the technologies to achieve societal objectives Policy Support Tool Stakeholder Reference Group Goal: To bridge the data and knowledge gap on the impacts of connected and automated transport systems (CATS) in terms of safety, mobility, environment and economic growth.	
Pilots sites	Manchester, Vienna	
Actors	**Industry**	Aimsun
	Science	**Loughborough University (coordinator)**, SWOV institute for road safety research, AIT Austrian Institute of Technology, The Institute of Transport Economics (TOI), Tongji University, CARRS-Q, NTUA, University of Michigan
	Government	Transport for Greater Manchester, The City of Vienna
	Other	POLIS
Site-specific learnings		
Key learnings		
Key resources	Policy Support Tool - https://levitate-project.eu/about/policy-support-tool-pst/	

MAVEN

Project	MAVEN

MOMENTUM

Project	MOMENTUM	
Period	2019 May - 2022 April	
Solutions	Tools to capture the impact of new transport options on urban mobility, supporting cities to design policies to exploit the full potential of emerging mobility solutions. Focus on MaaS, connected and autonomous vehicles, shared mobility services, and demand-responsive transport. **Decision Support Toolset**: Enhancement of Transport Simulation Frameworks with Models of Emerging Mobility Solutions Interactive Decision Support Toolset Policy Assessment Methodology	
Pilots sites	Thessaloniki, Regensburg, Madrid, Leuven Follower cities	
Actors	**Industry**	Aimsun
	Science	Transport & Mobility Leuven (TML), CERTH, University of Deusto, TUM School of Engineering and Design Technische Universität München
	Government	City of Thessaloniki, City of Regensburg, **EMT - Madrid (coordinator)**, City of Leuven
	Other	Nommon, POLIS, UITP
Site-specific learnings		
Key learnings		
Key resources	Modelling Emerging Transport Solutions for Urban Mobility State-of-the-art and future challenges - https://h2020-momentum.eu/wp-content/uploads/2020/05/MOMENTUM_White_Paper_Dec_2019.pdf	

ORCHESTRA

Project	ORCHESTRA	
Period	2021 May 2024 April	
Solutions	**Polycentric Architecture and Concept Model for a Multimodal Traffic Management Ecosystem** Defined functionality for traffic orchestration, including Data management and governance, Decision support and decision making, and Operative traffic management	
Pilots sites	Malpensa Airport, Milano; Herøya Industry Park, Norway	
Actors	**Industry**	Site-specific: Malpensa Airport, Milano: SEA Milano, Malpensa Airport, FSTechnology SpA, Information Sharing Company SRL Herøya Industry Park, Norway: Herøya Industry Park, Applied Autonomy AS General: **ITS Norway (coordinator)**, IOTA Foundation, Deep Blue SRL, CertX AG
	Science	SINTEF AS, TU Delft, Institut für Klimaschutz, Energie und Mobilität, Ökonomie und Politik EV, Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement

Project	ORCHESTRA	
		Cerema, University of Applied Sciences and Arts of Western Switzerland
	Government	Malpensa Airport, Milano: Enav SpA Herøya Industry Park, Norway: Norwegian public roads administration
	Other	
Site-specific learnings	Malpensa Airport, Milano Multimodal traffic management measures for resilient door-to-gate (airport) mobility of passengers Integrating air traffic data/ flights status with information on traffic flow and condition on the access network (railways and roads) Herøya Industry Park, Norway Traffic management across networks (public and private roads) and modes (road, rail, sea) for freight transport Integration of connected and automated vehicle (CAV) with traffic management (escort vehicles)	
Key learnings		
Key resources		

POSSE

Project	POSSE	
Period	2012 January - 2014 December	
Solutions	Guide to open specs and standards and Open ITS Systems Forum Project overview: Use of open specifications and standards in traffic management to avert vendor lock-in and promote a healthy market place Builds on two existing national frameworks: UTMC in UK and OCIT/OTS in DACH. Both national frameworks are the outcome of collaboration between the public authorities (customers) and companies (suppliers)	
Pilots sites		
Actors	**Industry**	
	Science	Czech Transport Research Centre (CDV)
	Government	**Reading Borough Council (coordinator)**, City of Pisa, City of Klaipeda, City of Burgos, City of La Spezia, Norwegian Public Roads Administration
	Other	UTMC Ltd, OCA e.V., POLIS
Site-specific learnings		
Key learnings	From CIVITAS Tool Inventory: Good Example Cambridge Automatic dissemination of traveller information via twitter and Facebook through Urban Traffic Management Control (UTMC) is an example of innovation delivered by new companies entering the market due to open systems. Liverpool UTMC Strategies are able to implement automated responses to event management combining data from a number of sources, managing area wide signals in response to this and the provision of traveller information. Frankfurt Open Communication Interface for Road Traffic Control Systems (OCIT) has resulted in significant cost savings in the 160 junctions upgraded.	

Project	POSSE
	Reading car park systems and traffic management systems, all Reading had to do was
Key resources	Guide to open specs and standards - https://civitas.eu/tool-inventory/posse-guide-to-open-specifications-and-standards-in-its

Annex II Relevant standards

Standards concerning the DATEX II framework:

- EN 16157-1:2018: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 1: Context and framework
- EN 16157-2:2019: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 2: Location referencing
- EN 16157-5:2020: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 5: Measured and elaborated data publications
- EN 16157-7:2018: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 7: Common data elements
- CEN TS 16157-8:2020: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 8: Traffic management publications and extensions dedicated to the urban environment
- CEN TS 16157-12:2021: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 12- Facility related publications

Standards concerning the communications and connectivity of traffic management systems.

- ISO 14827-1:2005: Transport information and control systems Data interfaces between centres for transport information and control systems Part 1: Message definition requirements
- ISO 14827-2:2005: Transport information and control systems Data interfaces between centres for transport information and control systems Part 2: DATEX-ASN
- ISO 14827-3:2019: Transport information and control systems Data interfaces between centres for transport information and control systems Part 3: Data interfaces between centres for intelligent transport systems (ITS) using XML (Profile A)
- CEN ISO 14827-4 Transport information and control systems - Data interfaces between centres for transport information and control systems - Part 4: Data interfaces between centres for intelligent transport systems (ITS) using XML (Profile B)
- CEN ISO TS 19468:2019: Intelligent transport systems - Data interfaces between centres for transport information and control systems - Platform independent model specifications for data exchange protocols for transport information and control systems
- CEN TS 17466:2020: Intelligent transport systems - Urban ITS - Communication interfaces and profiles for traffic management

Standard concerning the data exchange and input for asset systems:

- CEN TS 17268:2018: Intelligent transport systems - ITS spatial data - Data exchange on changes in road attributes

Standards concerning integration of a variety of traffic management tools:

- CEN TR 17401:2020: Intelligent transport systems - Urban-ITS - Mixed vendor environment guide
- CEN TS 17400:2020: Intelligent transport systems - Urban ITS - Mixed vendor environments, methodologies & translators
- CEN TS 17402:2020: Intelligent transport systems - Urban ITS - Use of regional traffic standards in a mixed vendor environment

Standard concerning the road safety aspect:

- ISO 39001:2012: Road traffic safety (RTS) management systems Requirements with guidance for use\

Standard concerning the design, implementation, and operation of traffic signals:

- EN 50556:2018: Road traffic signal systems
- EN 12368:2015: Traffic control equipment - Signal heads
- EN 12675:2017: Traffic signal controllers functional safety requirements
- EN 50293:2012: Electromagnetic Compatibility - Road Traffic Signal Systems
- CEN TS 16157-9:2020: Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 9: Traffic signal management publications dedicated to the urban environment
- CEN TS 17241:2019: Intelligent transport systems - Traffic management systems - Status, fault and quality requirements
- CEN TS 17400:2020: Intelligent transport systems - Urban ITS - Mixed vendor environments, methodologies & translators
- ISO 15784-1:2008: Intelligent transport systems (ITS) Data exchange involving roadside modules communication Part 1: General principles and documentation framework of application profiles
- ISO TS 19082:2020: Intelligent transport systems Definition of data elements and data frames between roadside modules and signal controllers for cooperative signal control
- ISO 20684-1:2021 Intelligent transport systems Roadside modules SNMP data interface Part 1: Overview
- ISO 20684-2:2021: Intelligent transport systems Roadside modules SNMP data interface Part 2: Generalized field device Basic management
- ISO TS 20684-10:2021 Intelligent transport systems Roadside modules SNMP data interface Part 10: Variable message signs
- ISO 22951:2009: Data dictionary and message sets for pre-emption and prioritization signal systems for emergency and public transport vehicles (PRESTO)