This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 953783.

Distributed Solutions for Multimodal Traffic Management

THE WAY FORWARD

DIT4TraM

INTRODUCTION

Purpose

The DIT4TraM project is at the forefront of transforming urban mobility by developing control concepts and algorithms inspired by swarm intelligence. By implementing these solutions, authorities can overcome issues like bottlenecks, unpredictable traffic flows, and the increasing demand for sustainable transport. It provides a clear path forward for cities looking to enhance their urban mobility systems, with a focus on the practical benefits that have been realised. A report containing more technical and detailed recommendations practitioners is available for further reading.

€100billion
Annual cost of congestion to the EU economy[1]

40%
Urban mobility's contribution to CO2 emissions from road transport[2]

European cities are increasingly challenged by transportation and traffic issues. In response to these pressing concerns, DIT4TraM, (Distributed Intelligence & Technology for Traffic & Mobility Management) has introduced a transformative approach to urban mobility management. The project, focused on developing and implementing a distributed control system designed to optimize traffic flow, improves public transport efficiency, and promote sustainable travel options. By utilising advanced technologies such as Big Data, AI, and cooperative vehicle systems, the project has contributed to the creation of a more resilient, responsive, and sustainable transportation network meeting the evolving needs of cities.

The Need for Multimodal Mobility and Network Optimisation

The complexity of modern transportation systems, driven by rapid technological advancements and societal changes, has made traditional, centralised traffic management methods less effective. In light of this, DIT4TraM showcases the significance of a multimodal and network-optimised approach to urban mobility. The project integrated various modes of transport—buses, trains, bikes, and cars—into a cohesive system, thereby enhancing the efficiency and accessibility of urban transport networks. This approach not only reduced congestion but also aligned with the EU's broader goals of creating a climate-neutral, safer, more secure, and inclusive transport sector.

Discover the innovative tools and technologies developed by DIT4TRAM, and see how they were successfully implemented in pilot cases to enhance mobility solutions across various cities.

1. European Court of Auditors. Urban Mobility in the EU. 2019
2. European Commission. The New EU Urban Mobility Framework. 2021

DIT4TraM in short

Project Name

Distributed Intelligence and Technology for Traffic and Mobility Management

Funding: EU Horizon 2020 Research and Innovation Programme, Grant Agreement No 953783

Budget: EUR 4,997,122

Duration: Sep 2021 – Sep 2024

The partners represent the following countries: Belgium, Cyprus, France, Germany, Greece, Israel, the Netherlands, Spain, and Switzerland.

Applications: Swarm intelligence-based traffic management solutions across several areas:

- Connected traffic management
- Distributed traffic management
- Demand management
- Transport service cooperation

Project Partners

AMS Amsterdam Institute for Advanced Metropolitan Solutions
Bar-Ilan University
EPFL
ETH zürich
TU Delft
Université Gustave Eiffel
aimsun.
Arane
SIEMENS
gertrude
NeoGLS Intelligent Transport
oseven
BORDEAUX MÉTROPOLE
Gemeente Amsterdam
POLIS
Technolution
City of Utrecht
D.E.I.A. ltd

Objectives Achieved by DIT4TraM

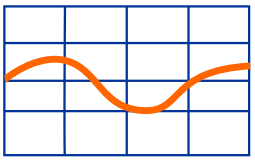
The project innovative solutions provide cities with the tools they need to embrace a smarter, more sustainable future for urban mobility, ensuring that all residents benefit from improved and more accessible transportation services. The following objectives outline the key achievements that have made this transformation possible.

A scalable traffic management system

The project successfully delivered a practical, distributed control system adaptable to various urban and road environments with the DNTM system. This system, designed for scalability, allows cities to manage traffic effectively by decentralising decision-making. As a result, cities experienced quicker responses to real-time traffic conditions, leading to reduced bottlenecks and improved traffic flow.

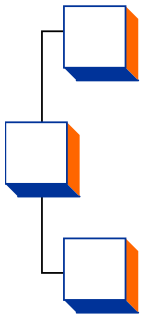
Advanced technologies for proactive traffic management

Through the integration of cutting-edge monitoring tools and AI-driven forecasting models, the project enabled cities to predict and manage traffic flows with precision. This proactive approach anticipated traffic patterns and adjusted infrastructure such as traffic signals and public transport schedules, ensuring smoother, more efficient movement throughout urban areas.



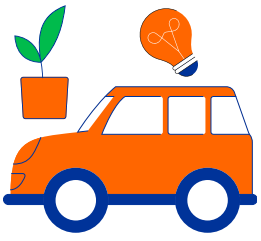
Decentralisation for efficient information sharing and cost savings

DIT4TraM has identified the optimal level of information sharing needed to support decentralised traffic management, proving it to be more efficient and cost-effective than centralised systems. This approach reduces costs related to sensing, communication, and maintenance, while also increasing the reliability of urban transport systems. The strategies effectively managed urban challenges such as sensor failures and data inaccuracies, ensuring reliable performance in a variety of conditions.



Promoting seamless, sustainable, and connected mobility

The tools developed were instrumental in facilitating the transition of urban areas towards seamless, sustainable and connected mobility systems. These systems enhanced the liveability, safety, and resilience of cities, thereby contributing to broader societal goals. This approach led to significant improvements in urban mobility, making it more efficient, inclusive and fair. It addressed key issues such as privacy protection, public participation and environmental sustainability.



Better public transport and shared mobility

By integrating public transport and shared mobility services into a cohesive network, DITraM made sustainable travel options more accessible and appealing. This integration led to a significant reduction in the reliance on private cars, lowering emissions and fostering healthier urban environments. The project focused on making public and shared transport both efficient and convenient, encouraging widespread adoption among residents.

BENEFITS FOR LOCAL GOVERNMENTS

As urban areas grow and transportation networks become more complex, traditional centralised traffic management systems are unable to cope with the increased demand. The emergence of new travel options and evolving policies requires a new approach that can adapt quickly and efficiently to the ever-changing urban landscape.

The introduction of decentralised traffic control systems and advanced network optimisation tools represents a significant step forward in the way cities manage their transportation networks. These innovative solutions offer more than just operational improvements, paving the way for a future where congestion is minimised, safety is maximised and various modes of transport work together seamlessly. The true impact of these advancements lies in the tangible benefits they bring to local governments, which can shape the future of urban mobility in profound ways.

Improved traffic efficiency, safety, and congestion management

- **Optimised traffic flow**: DIT4TraM's distributed control system reduces congestion by optimizing traffic signals and managing traffic flows more effectively across the city. This leads to smoother commutes, reduced travel times, and fewer traffic jams, making the urban environment safer and more efficient for all road users.
- **Safety first**: By prioritizing certain modes of transport, such as bicycles and public transit, the system reduces the likelihood of accidents and improves safety for all users. The system can quickly adapt to unexpected situations – like accidents or road works – helping to prevent further issues and keep everyone safer on the move.

Data-driven urban planning

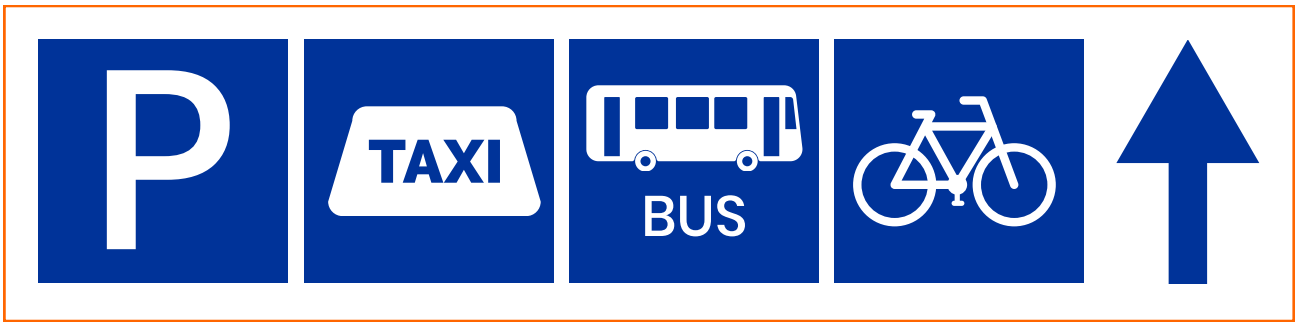
- **Real-time insights**: The platform provides urban planners with real-time data and advanced forecasting tools that allow them to make informed decisions about traffic management, public transport schedules, and infrastructure investments.
- **Predictive analytics**: The project's AI-driven models help predict traffic patterns and potential congestion points, enabling planners to proactively address issues before they escalate, leading to more resilient and adaptable urban transportation systems.

Better integration of transport modes

- **Seamless multimodal integration:** The project solutions connects different transport modes into a single, cohesive network, making it easier for residents to switch between buses, trains, bikes, and other forms of transport. This integration promotes the use of public transport and shared mobility options, reducing the reliance on private vehicles and lowering emissions.
- **Support for sustainable transport:** By encouraging the use of more sustainable transport options, such as shared mobility and public transport, cities meet their environmental goals and reduces the overall carbon footprint of urban mobility.

Synergy with regional and local transport strategies

- **Supporting sustainability initiatives:** DIT4TraM's focus on reducing congestion and promoting sustainable transport aligns with many cities' environmental and climate action plans. The project supports cities in their efforts to achieve sustainability targets, such as reducing greenhouse gas emissions and improving air quality as it is the case in Bordeaux's mobility plan
- **Contributing to economic efficiency:** By improving traffic flow and reducing congestion, the tools help to minimize the economic costs associated with traffic delays and accidents. This aligns with regional goals to enhance economic productivity and improve the quality of life for residents. Cases like the Mediterranean Highway and the Utrecht pilot proved an economic benefit both for users and for the management systems.
- **Facilitating inclusive urban development:** The project's emphasis on equitable access to transportation aims at ensuring that all citizens, regardless of socioeconomic status, have access to efficient and affordable mobility options. This supports broader policy goals related to social equity and inclusive urban development, as the Glyfada pilot demonstrated.



DIT4TRAM TOOLS AND APPLICATIONS

Achieving the objectives our approach relies on the advanced tools and technologies developed by our project. These tools are crucial for optimizing urban mobility, improving traffic management, and fostering sustainable transportation systems. With our innovative approach, cities can effectively address the complex challenges of modern transportation and unlock the full potential of DIT4TraM's solutions.

Cooperative Distributed Control System

A core component of the approach, this system decentralises traffic management, allowing for real-time decision-making at multiple points across the network. This approach enhances the responsiveness and adaptability of traffic management, reducing congestion and improving overall traffic flow.

Utrecht pilot

Discover tools and outputs D3.1, D3.2, D3.3 & D3.4

Incentive-Based Traffic Management

This tool uses incentive mechanisms to both manage bottlenecks and encourage the use of sustainable transport modes, such as cycling, walking, and public transit. By offering benefits like priority at traffic signals or discounts on public transport, the system promotes behaviours that reduce congestion and environmental impact.

Bordeaux pilot

Discover tools and outputs D2.1, D2.2, D2.3 & D2.4

Tradable Mobility Permits Schemes

An innovative approach to managing demand on busy roadways, these schemes allocates a limited number of mobility credits to drivers, which they can trade based on their travel needs. This market-based tool helps balance demand across the transport network, reducing congestion and optimizing the use of available infrastructure.

Amstedam and Mediterranean pilot

Discover tools and outputs D4.1, D4.2, D4.3 & D4.4

DIT4TraM TOOLS AND APPLICATIONS

Fair Cooperation Schemes

Aimed at balancing the diverse needs of urban transportation stakeholders, these schemes establish a collaborative framework where public authorities, private mobility providers, infrastructure managers, and users work together towards common objectives. By promoting equitable decision-making and resource sharing, these schemes ensure that all parties contribute to and benefit from the transportation system.

Glyfada Pilot

Discover tools and outputs
D5.1, D5.2 & D5.3

DIT4TraM Traffic and Mobility Management System

Developed as a comprehensive solution, this system integrates predictive and virtual test capabilities to optimize traffic across multimodal networks. The system's architecture connects various actors, from traffic demand and supply management modules to the end-users, ensuring a seamless and efficient transportation network. These tools, along with others, were integrated into the system to simulate and manage various traffic conditions and scenarios, ensuring robust and efficient urban and interurban transportation management.

Athens pilot

Discover tools and outputs
D6.4 & D6.5

Smart Infrastructure Readiness Index (SIRI)

SIRI is a tool designed to assess a city's preparedness to deploy intelligent transportation systems (ITS) and embrace a distributed paradigm. It allows city authorities to gauge their progress, prioritize investments, and stay at the forefront of innovation in urban mobility.

Discover tools and outputs
D8.3

DIT4TraM pilots

Bordeaux Pilot: Traffic management solutions at intersections for cyclists and carpoolers

Bordeaux tackled traffic congestion and promoted sustainable travel by implementing a **system that prioritizes cyclists and carpoolers at key intersections**. As a growing city, Bordeaux faces significant challenges with congestion, particularly during peak hours. This congestion not only increases travel times but also negatively impacts air quality and the overall quality of life for its residents. The city's approach focuses on creating a more efficient and environmentally friendly transportation network, ensuring that all road users can benefit from improved mobility and reduced congestion.

Solution

The pilot project **utilizes innovative tools developed, including advanced routing algorithms and smart applications.** These tools enable the efficient matching of passengers with vehicles, optimizing routes in real-time based on demand, and providing a user-friendly experience through a dedicated mobile app.

Technologies used

Smart Traffic Signals

These signals use real-time data to adjust based on current traffic, giving priority to bicycles and carpool vehicles.

Incentive-Based Traffic Management

A tool developed within DIT4TraM that encourages people to use more sustainable modes of transport by making their journeys quicker and easier.

Implementation

The focus was on two busy intersections where cyclists and carpoolers frequently experienced delays. At the Larminat-Pompidou-Gautier Intersection, a complex 4-leg intersection serving around 3,000 cyclists daily, efforts were made to reduce delays and stops for cyclists. Meanwhile, at the Mitterrand x Parking Arlac Intersection, which provides access to a park-and-ride facility, HIGH Ocuppancy Vehicles, technical term that can be applied to carpoolers, prioritization was tested to enhance accessibility.

Bordeaux Pilot

Benefits

Less Congestion

Cyclists and carpoolers are now experiencing less waiting time at traffic lights, which helps reduce overall congestion. During the testing period, the average speed of cyclists saw a modest increase, with an **average rise of between 1 and 2 km/h.**

Improved Traffic Flow

Real-time adjustments to traffic signals have resulted in enhanced traffic flow through areas of the city. The introduction of a virtual push-button system has resulted in **an average reduction of 5 seconds in activation time for the bicycle phase**, compared to traditional methods. The resulting improvement in traffic flow and reduction in waiting times for cyclists is a testament to the success of this initiative.

Challenges

Integrating new technologies with existing traffic systems presented significant challenges, particularly with communication timing and controller flexibility. However, by collaborating effectively and using DIT4TRAM's tools, these issues were successfully addressed, enabling the pilot to meet its objectives.

Future potential

This pilot marks the beginning of broader opportunities. The tools and strategies developed in Bordeaux have the potential to be expanded not only within the city but also to other urban areas facing similar challenges.

Why this is important for Bordeaux?

The Bordeaux pilot provides an excellent case study demonstrating how smart city technologies can effectively address urban challenges. It highlights the value of integrating technology with policy to drive positive change, enhancing road network efficiency, reducing travel times and prioritising sustainable transport modes like cycling.

The pilot aligns with Bordeaux's 2020-2030 mobility plan, which focuses on decarbonising transportation, promoting shared mobility, and enhancing public transport and cycling. By demonstrating the practical benefits of these strategies, the pilot supports policy goals and encourages further adoption of similar initiatives.

The success of the Bordeaux pilot provides a solid foundation for the broader implementation of smart traffic management systems throughout the city.

DIT4TraM pilots

Utrecht Pilot: Dynamic traffic flow and bicycle prioritisation

Utrecht redesigned a key traffic corridor to tackle congestion and enhance the quality of life for residents. The **Western City Boulevard** in Utrecht is a critical route that has been struggling with high levels of car traffic, leading to congestion and environmental issues. As Utrecht continues to grow, these problems are expected to worsen without intervention. The goal: turning the Western City Boulevard into a more efficient and attractive city boulevard, with fewer car lanes and better space for pedestrians and cyclists.

Solution

The project introduced an **Integrated Network Management** system that dynamically manages traffic flows, prioritises bicycles, and uses advanced data techniques to improve overall traffic efficiency.

Technologies used

Integrated Network Management

This decentralized system manages traffic at multiple intersections, adjusting traffic light timings in real-time to optimize flow and reduce congestion.

Floating Car Data

Utilized to gather real-time information from vehicles on the road, helping to estimate traffic queues and adjust traffic management strategies more effectively.

Implementation

- Bicycle priority: The project aimed to enhance cycling conditions at two major intersections by leveraging the project's advanced traffic management tools. Traffic signals were adjusted to prioritize cyclists, reducing their waiting times and promoting safer, more efficient travel. The system autonomously optimized signal timings based on real-time data, adapting to varying traffic conditions and minimizing disruptions for other road users.

- Floating car data Integration: The project explored the integration of real-time Floating Car Data as a potential replacement for traditional radar systems in traffic monitoring. Through simulations and trials, FCD was evaluated for its effectiveness in estimating traffic queues and managing flow, particularly in less critical areas. This approach aimed to make traffic management more cost-effective, while maintaining accuracy and responsiveness in real-time traffic adjustments.

Utrecht Pilot

Benefits

Improved Traffic Flow

The real-time adjustments to traffic signals led to a noticeable reduction in congestion, particularly benefiting cyclists and carpoolers. These changes contributed to a more efficient and balanced urban traffic network, enhancing overall mobility.

Cost Efficiency

The integration of Floating Car Data demonstrated potential as a cost-effective alternative to traditional traffic monitoring systems. By reducing reliance on expensive radar setups, the project highlighted ways to optimize traffic management without compromising on accuracy, offering long-term savings for the city.

Challenges

New data-driven technologies such as FCD with existing traffic systems proved challenging, especially regarding data delays and accuracy. Despite these hurdles, valuable insights were gained, which will inform and improve future implementations. The project underscored the need for continued refinement of these technologies to ensure their effectiveness in complex urban environments.

Future Potential

The tools and strategies tested in Utrecht have significant potential for broader application. With further refinement, particularly in enhancing data accuracy and integrating additional data sources, these solutions could be scaled to other urban areas. This would help cities across Europe improve traffic management, reduce congestion, and enhance overall urban mobility.

Why This Is Important for Utrecht?

This pilot project demonstrates the significant benefits of using advanced, data-driven tools to address urban mobility challenges. By prioritising cyclists and optimising traffic flow, the project not only addresses immediate concerns, but also lays the groundwork for a more sustainable and liveable future in Utrecht. The success of this initiative demonstrates that with the right strategies and technological tools, meaningful improvements can be made to the functionality of urban areas, significantly improving the quality of life for all residents.

DIT4TraM pilots

Amsterdam Pilot: Rethinking city travel with Tradable Mobility Credits

Amsterdam adressed the pressing challenge of limited public space by introducing innovative approaches to mobility management. With the city's population and job market growing rapidly, public spaces are becoming more crowded, requiring bold decisions about how to allocate space. This pilot project explores the use of Tradable Mobility Credits as a tool to manage the city's mobility needs effectively, balancing accessibility with sustainability.

Solution

The Amsterdam pilot leverages DIT4TraM's Tradable Mobility Credits, a novel system that allows citizens to trade mobility credits in a market-based environment. This system incentivizes the use of sustainable transport modes, helping to reduce the negative impacts of mobility while ensuring accessibility for all.

Technologies used

Trade Mobility Credits (TMCs)

TMCs are a market-based system where citizens are allocated a certain number of credits that can be used to access various modes of transport. Credits can be traded, allowing for flexibility and incentivizing the use of more sustainable transport options like cycling and public transit.

Implementation

- Behavioural Experiments: To understand how people would interact with TMCs, behavioural experiments were conducted, simulating how individuals make travel decisions when credits are involved. This helps policymakers understand the potential impact of TMCs on travel behaviour and mobility choices.
- Serious Gaming: Participants engaged in a serious game where they could buy and sell mobility credits in real time, providing insights into how a market-based system could operate in practice. This interactive approach helped test the feasibility and effectiveness of TMCs in managing urban mobility.

Amsterdam Pilot

Benefits

Enhanced Mobility Choices

The implementation of the Tradable Mobility Credits system has provided residents with greater flexibility in their transportation choices. By allowing the trading of mobility credits, the system incentivizes the use of more sustainable and space-efficient transport modes, such as biking and public transport. This encourages a shift away from private car usage, promoting a more balanced and environmentally friendly urban mobility system.

Improved Space Management

The TMC system plays a crucial role in optimizing the use of Amsterdam's limited public space. By managing the demand for different transport modes through tradable credits, the system aligns the allocation of space with the city's broader sustainability and liveability goals.

Challenges

Implementing a market-based system like Tradable Mobility Credits presents several challenges, particularly in ensuring that all residents understand and can effectively participate in the system. Issues such as the influence of weather conditions, cost sensitivity, and potential inequalities in credit distribution must be carefully managed. However, the pilot has demonstrated that with proper education, engagement, and dynamic adjustments, these challenges can be successfully addressed.

Future Potential

The insights gained from this pilot suggest that TMCs have significant potential to be expanded not only to other parts of Amsterdam but also to cities facing similar space and mobility challenges. The system's flexibility, including its ability to dynamically adjust credit supply and pricing based on real-time data, allows it to be adapted to a wide range of urban environments. This adaptability makes TMCs a valuable tool for future urban planning, offering a scalable solution to enhance traffic management, reduce emissions, and promote sustainable transport.

Why This Is Important for Amsterdam?

This pilot project represents a critical advancement in Amsterdam's efforts toward sustainability and urban innovation. By implementing Tradable Mobility Credits, the city is pioneering a novel approach to managing urban space and encouraging sustainable transport choices, directly contributing to reduced congestion and lower emissions. The adaptability of the TMC system, supported by real-time data and dynamic pricing, ensures that it can evolve alongside the city's changing needs. Furthermore, the pilot showed the importance of inclusivity and fairness, ensuring that all residents, regardless of income or digital literacy, can benefit from these innovations.

DIT4TraM pilots

Glyfada Pilot: Real-time On-Demand transport integration

Glyfada, a popular city located south of Athens, faces significant traffic congestion due to its popularity and limited public transport options. This reliance on cars leads to frequent congestion, especially during peak hours. The main objective of this pilot project was to introduce a novel on-demand transportation service that integrates with the existing public transit system. This service is designed to improve the efficiency of the road network and reduce the reliance on private vehicles by offering a convenient and flexible alternative for short trips within the city.

Solution

The pilot project tested innovative tools developed, including advanced routing algorithms and smart applications. These tools enable the efficient matching of passengers with vehicles, optimizing routes in real-time based on demand, and providing a user-friendly experience through a dedicated mobile app.

Technologies used

On-Demand Service with Dynamic Routing

The service uses DIT4TraM's advanced routing algorithms (available at WP3) to dynamically match passengers with available vehicles, determining the most efficient routes in real-time.

Smart Applications

The project developed two user-friendly mobile applications—one for passengers and one for drivers. These apps facilitate the booking and management of rides, ensuring a seamless experience for users.

Implementation

- Service Design: The service operates with four small, flexible van-type vehicles, each with a capacity of six passengers. Passengers can request rides through the mobile app, selecting from 11 strategically located stations within Glyfada. The routing algorithm then determines the optimal route for each vehicle based on current demand, minimizing wait times and detours for passengers.

- SmartBus App: The "SmartBus" app, developed as part of the project, allows users to easily book rides, track their vehicle in real-time, and receive notifications about their trip. The app is designed to be simple and accessible, catering to all users, including those who may not be tech-savvy.

Glyfada Pilot

Benefits

Reduced Traffic Congestion

The on-demand service effectively alleviates traffic congestion, especially during peak hours, by offering a viable alternative to private car usage. With an **average trip duration of 10.66 minute**s, the service has shown efficiency in transporting passengers, reducing the need for individual car trips.

increased Public Transport Usage

By complementing existing public transport options, the service encourages more residents and visitors to shift from private vehicles to shared, sustainable modes of transport. The system's ability to attract users, as reflected in the **82% positive user experience rating**, indicates its potential to increase public transport usage.

Challenges

While the introduction of this on-demand service faced challenges such as longer waiting and detour times, the pilot demonstrated that with algorithm refinement and enhanced user communication, these issues can be mitigated. Continued user engagement and addressing concerns about waiting times and app functionality are crucial for long-term success.

Future Potential

The success of the Glyfada pilot highlights the potential for expanding this on-demand service to other parts of the city or similar urban areas. With further algorithm improvements to reduce wait times and increase occupancy rates, the tools and methodologies can be adapted and scaled to enhance urban mobility in various environments.

Why This Is Important for Glyfada?

Glyfada's pilot proves the importance of integrating innovative, on-demand transport services into urban mobility systems. Glyfada is pioneering a more efficient, sustainable, and accessible city model. The high user satisfaction rate and the system's potential for reducing traffic congestion demonstrate that this approach can significantly improve daily life for residents and visitors. Furthermore, Glyfada's experience sets a valuable precedent for other cities aiming to tackle their own mobility challenges, showing that with the right strategies, significant improvements in urban transport are achievable.

DIT4TraM pilots

Athens Pilot: AI-Driven traffic management

Athens is a metropolitan city struggling with significant traffic congestion, especially in its city centre. The objective of this pilot project was to improve traffic flow and reduce congestion by deploying advanced AI-driven traffic management strategies. These strategies are designed to optimize the city's transportation system, making it more efficient, adaptable, and responsive to real-time conditions.

Solution

The Athens pilot employed methodologies developed within the project, including AI-driven reinforcement learning and decentralized multi-agent systems. These tools are used to manage and optimize traffic flow across the city's network, particularly targeting the prevention of gridlock and the reduction of travel times during peak hours, thereby improving overall urban mobility.

Technologies used

Reinforcement Learning and AI

The project deployed a centralised reinforcement learning agent and a cooperative decentralized multi-agent system to control traffic in real-time. These systems learn from traffic patterns and make decisions to optimize traffic flow and reduce congestion.

Multi-Region Perimeter Control

This system helps manage the inflow and outflow of vehicles in different parts of the city, preventing congestion from spreading and maintaining smooth traffic throughout the day.

Implementation

- Simulated Network: A microsimulation of Athens' city centre was created to test and refine these AI-driven traffic control strategies. The system was trained to handle various traffic scenarios, including peak-hour congestion and disruptions, ensuring that the traffic flow remained optimal even during challenging conditions.

- Real-Time Traffic Management: The AI systems continuously monitor and adjust traffic signals and vehicle flows to prevent gridlock and ensure that traffic moves efficiently through the city, especially in the most congested areas.

Athens Pilot

Benefits

Reduced Traffic Congestion

The implementation of this traffic management systems in Athens led to a significant reduction in vehicle hours travelled and total travel times. These systems made commuting faster and more predictable, reducing overall congestion and enhancing the efficiency of the city's transportation network. In peak-hour scenarios, **the tools reduce the vehicles per hour by approximately 23% compared to scenarios without perimeter control and outperformed traditional methods by 6-7%**.

Improved Traffic Flow

The pilot demonstrated a marked improvement in traffic flow, particularly during peak hours and in disruption scenarios, such as road closures. The AI algorithms optimized traffic signal timings and dynamically adjusted to real-time conditions, **cutting total travel time by up to 55% in some scenarios**. Although there was a slight increase in total departure delays compared to traditional methods, the overall efficiency gains were substantial, making the system highly effective in maintaining a smooth traffic flow.

Challenges

Implementing advanced AI-driven traffic management strategies in Athens required extensive simulation and testing to ensure their effectiveness in the city's complex urban environment. The complexity of Athens' traffic patterns, coupled with the need for the AI models to adapt to real-world conditions, posed significant challenges. However, despite these hurdles, the pilot successfully showcased the potential of these advanced tools to transform urban mobility, balancing efficiency with real-time adaptability.

Future Potential

These technologies can be expanded to other parts of Athens or applied to similar urban environments, providing a robust solution for cities looking to improve traffic efficiency, reduce congestion, and enhance sustainability. The adaptability of AI systems to various traffic scenarios, including unexpected disruptions, underscores their value as a critical tool for future urban mobility strategies.

Why This Is Important for Athens?

The success of this initiative highlights the transformative potential of AI-driven traffic management in creating lasting positive changes in urban mobility. Moreover, the project's ability to manage traffic during peak hours and disruptions, while maintaining high trip completion rates, sets a strong precedent for how other cities can leverage AI to tackle their own mobility challenges, ultimately contributing to a more resilient and forward-thinking urban future.

DIT4TraM pilots

Mediterranean Highway Pilot: Tradable Credit schemes for traffic optimisation

The Mediterranean Highway (AP-7) is a crucial transportation artery in Spain, linking eastern regions and facilitating a significant volume of interurban traffic. Since the removal of tolls on this highway, congestion has increased significantly, resulting in a decline in the level of service. The objective of this pilot project is to address these challenges by testing innovative demand management strategies, with a view to more efficiently managing traffic flow and alleviating congestion on the AP-7.

Solution

The pilot used the Tradable Credit Scheme (TCS), a novel approach that allows drivers to trade mobility credits for access to the AP-7. The TCS provides a flexible alternative to traditional tolling, controlling access through a system of tradable credits to balance traffic demand and improve road performance. This system encourages the use of alternative routes or transport modes, balancing the demand across the network and alleviating congestion.

Technologies used

Tradable Credit Scheme (TCS)

The TCS is a demand management tool that allocates a limited number of mobility credits to drivers. These credits are required to access the AP-7, and drivers can buy or sell them depending on their travel needs. This market-driven approach helps manage traffic by incentivizing drivers to choose alternative routes or modes of transport when congestion is high.

Dynamic Traffic Simulation

The pilot used a detailed simulation of the AP-7 and surrounding roads to test how different levels of credit allocation affect traffic flow, congestion, and overall efficiency.

Implementation

- Dynamic Traffic Management: The pilot incorporated advanced simulation models to predict and manage traffic flow in real-time. These models were calibrated with historical and current traffic data to accurately reflect post-pandemic conditions, ensuring that the strategies tested were relevant and effective for current traffic patterns.

- Simulation Scenarios: Various scenarios were simulated to evaluate the impact of different credit allocations on traffic distribution between the AP-7 and the N-II. By adjusting the number of tradable credits available to drivers, the simulations tested how effectively the TCS could reduce congestion on the AP-7 while avoiding excessive traffic on the N-II. The optimal credit allocation, around 70-80%, was found to significantly alleviate congestion on the AP-7 without overburdening secondary routes.

Mediterranean Highway Pilot

Benefits

Reduced Traffic Congestion

The implementation of the TCS significantly decreased the number of vehicles on the AP-7 during peak times. By optimizing the allocation of credits, the system effectively reduced travel times, delays, and overall congestion, leading to smoother traffic flow and improved levels of service, particularly during critical periods. The TCS demonstrated that a credit allocation of approximately 70-80% was most effective in maintaining high speeds and minimizing congestion.

Balanced Traffic Distribution

The pilot also successfully promoted a more balanced distribution of traffic across the entire network. By incentivizing drivers to either use alternative routes like the N-II or adjust their travel times, the system prevented bottlenecks on the AP-7 and enhanced overall network efficiency. However, it was crucial to ensure that lower TCS allocations did not inadvertently shift too much traffic onto secondary roads, which could lead to congestion and reduced network performance.

Challenges

The TCS required meticulous calibration to manage traffic demand without merely shifting congestion to other parts of the network. The pilot revealed that while the TCS effectively reduces congestion on the AP-7, achieving this requires a delicate balance. Allocations below the optimal range (70-80%) increased the risk of overloading alternative routes such as the N-II, highlighting the sensitivity of traffic patterns to even minor pricing changes. This underscores the importance of strategic planning, continuous monitoring, and the ability to make dynamic adjustments based on real-time data.

Future Potential

The Mediterranean Highway pilot demonstrates that Tradable Credit Schemes are a highly promising tool for managing interurban traffic. With further refinement, such as adjusting credit allocations and pricing strategies based on real-time conditions, this approach could be scaled to other highways across Spain and Europe. The flexibility of the TCS offers a market-based solution to address congestion, improve traffic flow, and reduce the environmental impact of road networks.

Why This Is Important for the Mediterranean Highway?

This pilot project is a crucial experiment in applying market-driven tools like Tradable Credit Schemes to manage traffic on major highways. By balancing traffic demand across different routes and reducing congestion, the project not only enhances travel efficiency but also supports broader goals of sustainability and economic growth. The success of the TCS on the AP-7 could serve as a model for traffic management on other congested highways in Spain and beyond, potentially revolutionizing how traffic is managed across entire road networks.

VISION

STEERING THE FUTURE OF TRAFFIC MANAGEMENT

The future of sustainable and connected cities and regions depends on creating a highly connected, intelligent, and resilient transportation system that seamlessly integrates all modes of transport—public transit, cycling, walking, and freight—into a unified, multimodal network. Effective traffic management is at the heart of this transformation, enabling us to move beyond the fragmented systems of today that lead to congestion, inefficiencies, and environmental strain. For that, it is needed to break down the silos and keep creating a seamless, sustainable, and accessible mobility network that boost the flow of people and goods, meeting the needs of all residents.

As part of the **Multimodal Traffic Management Cluster (MTMC)**, a collaborative initiative involving seven EU-funded research projects, DIT4TraM is not alone in these efforts. The Cluster aims to use the collective experience and expertise of its participating research projects to address emerging challenges and opportunities through a collaborative approach. By focusing on the creation of an integrated framework, it aims to develop future-proof solutions that support the seamless operation and management of different transport modes. For that reason, this report collects the jointly developed a roadmap by the cluster and add the specific approach of DIT4TraM.

This joint vision for the future of urban mobility will soon be published in greater detail by the MTMC, outlining the path forward for creating truly integrated and intelligent transportation networks.

mtmc Multimodal Traffic Management Cluster

TANGENT

Orchestra

DIT4TraM

FRONTIER FUTURE MOBILITY

SYNCHROMODE

DELPHI

Acumen

Integration of modes

- **Seamless transitions**: Coordinating different transport modes at multimodal hubs to ensure efficient and accessible mobility for all users, including those in rural and underserved areas. This includes integrating passenger and freight transport to optimise costs and environmental impacts.
- **Reduced environmental impact**: Promoting the use of zero-emission vehicles and integrated planning to minimise the environmental footprint of urban transport systems. This approach also includes a shift from the "user pays" to the "polluter pays" principle, internalising external costs related to environmental impact and air pollution.
- **Cost efficiency**: Reducing the overall cost of mobility by optimising the integration of transport modes, using centralised information systems and adopting sustainable urban mobility planning.

Cooperative, Connected, and Automated Mobility (CCAM)

- **Connected Infrastructure:** Developing and deploying cooperative, connected and automated mobility systems in which vehicles communicate with each other and with the infrastructure to optimise traffic flow, reduce delays and improve safety.

- **Intelligent Infrastructure:** Implementing intelligent traffic signals, real-time information systems and connected vehicle technologies to improve the responsiveness and adaptability of urban transport networks.

Stakeholder cooperation

- **Cooperative frameworks and public-private partnerships:** Foster cooperation between public authorities, private companies and citizens to ensure that all perspectives are taken into account in the development and implementation of multimodal transport solutions. Use successful public-private partnership models to align the objectives of different stakeholders.

Sustainability and resilience

- **Environmental sustainability:** Address the significant environmental impacts of current transport systems by integrating climate-friendly technologies and practices, such as dynamic multimodal traffic control and Mobility-as-a-Service (MaaS).

- **Disruption resilience:** Ensure that multimodal transport systems are resilient and adaptable to planned and unplanned disruptions by developing robust contingency plans, improving real-time monitoring capabilities and implementing proactive decision-making processes.

Public engagement and acceptance

- **Awareness and education:** Conduct public awareness campaigns, consultations and pilot projects to demonstrate the benefits of new multimodal transport technologies and secure public support for their adoption. Ensure that these advances are accessible and beneficial to all citizens, especially those in underserved areas.

- **Inclusive mobility solutions:** Promote inclusive and equitable transport solutions that meet the needs of all urban citizens, improve access and reduce barriers to mobility.

Call for Action

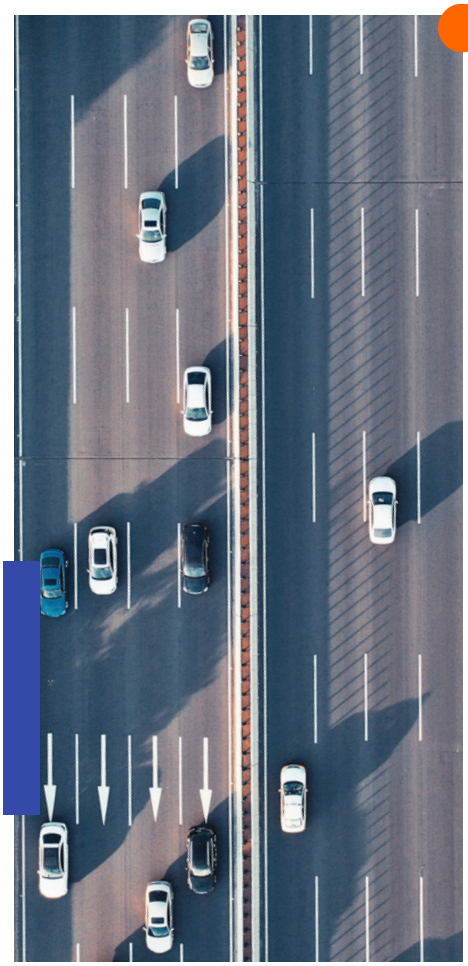
Paving the Way for the Future of Multimodal Urban Mobility

The future of our cities is closely linked to how we address today's complex transport challenges. As urbanisation accelerates and mobility demands increase, the need for more intelligent, integrated and sustainable transport systems becomes more urgent. DIT4TraM and the Multimodal Traffic Management Cluster are at the forefront of this transformation, providing cutting-edge tools and strategies to transform urban transport into a cohesive, efficient and environmentally sustainable network. However, the path to truly multimodal, resilient urban mobility is complex and requires a concerted effort across multiple sectors.

Together with the MTMC and its partner projects, we are calling for several key opportunities to make a significant impact on the future of urban mobility:

Driving innovation in urban mobility

Integrating different modes of transport - including buses, trains, cycling and walking - into a seamless, multimodal network is critical to reducing congestion and improving urban accessibility. Through sophisticated traffic management systems that enable real-time coordination and optimisation of traffic flows, cities can significantly improve the efficiency and fluidity of their transport networks. By adopting these advanced multimodal frameworks, urban areas can create a more connected and responsive mobility ecosystem, driving innovation at all levels of transport management.



Promoting cross-sector collaboration

The successful transformation of urban mobility landscapes depends on robust collaboration between cities, industries and research institutions. By engaging in collaborative networks and sharing best practices, stakeholders can accelerate the deployment of multimodal traffic management solutions that address the complex dynamics of urban mobility. This collective approach is essential to develop adaptive, future-proof transport systems that can respond to evolving challenges and opportunities.

Empowering the mobility workforce

Implementing these sophisticated multimodal systems requires a workforce that is not only skilled, but also well versed in the intricacies of modern urban transport. Investing in comprehensive training programmes and educational initiatives will equip urban planners and transport professionals with the expertise needed to manage and optimise complex, multimodal networks. These capacity-building efforts are essential to ensure that the future of urban mobility is managed by professionals who can effectively integrate innovative solutions into existing urban frameworks.

Working for sustainable urban transport

Tackling congestion, reducing emissions and improving urban accessibility are fundamental to creating more sustainable and liveable cities. By prioritising the introduction of sustainable transport options and optimising the use of existing infrastructure, cities can achieve significant environmental and social benefits. The collective efforts of the MTMC cluster, including DIT4TraM, are helping to drive the transition to a mobility future that is both efficient and sustainable, laying the foundations for urban environments that prioritise the well-being of their inhabitants.

As the first round of MTMC projects approaches completion, a new wave of initiatives is poised to build on the foundational work established by DIT4TraM, TANGENT, ORCHESTRA and FRONTIER. These upcoming projects (ACUMEN, SYNCHROMODE and DELPHI): will continue to push the boundaries of what is possible in multimodal traffic management, ensuring that the vision of a fully integrated, sustainable, and resilient urban mobility system remains within reach.

The DIT4TRAM project has delivered innovative solutions that address the growing challenges of urban mobility and traffic management. By embracing these advanced tools and strategies, authorities can reduce congestion, improve sustainability, and enhance the performance of public policy and quality of life. Now is the time for local leaders to take action, implement these solutions, and drive the transformation toward smarter, more resilient urban transportation systems. Let's work together to shape the future of our cities and regions.

DIT4TraM

DIT4TraM (Distributed Intelligence & Technology for Traffic & Mobility Management) 2024.

Title
Distributed Solutions for Multimodal Traffic Management - DIT4TraM THE WAY FORWARD

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 953783.

This report is part of Deliverable 9.6: DIT4TraM brochure publications for public audience.

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This report is part of Deliverable 9.6: DIT4TraM brochure publications for public audience.

Pictures
Picture front/back page: PetarBogdanov (Getty Images)
All other pictures. Authors: Sergiu Oana (p.5), SergiyN (p.9), CHUNYIP WONG (p.13), Sarra22 (p.17), curtoicurto (p.19), ballykdy (p.21), zhen tang (p.23)

Version 1.0 August 2024

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