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Extended ATM for Seamless Travel (X-TEAM D2D)

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1 Background and X-TEAM D2D goals

In the future (up to 2050), physical infrastructure, transport systems, traffic management, operational processes and information systems will be seamlessly

integrated. The combination of new emerging transport modes such as extended urban and regional air transport forms (SAT, PATS, UAM), electric and autonomous mobility (road, rail, water) with a passenger-centric view will revolutionize future mobility. A key enabler for this is integrating ATM into overall multimodal transport systems that will provide airports, authorities, transport companies and passengers with common and comprehensive information of the door-to-door (D2D) travel flows. The X-TEAM D2D project explores and analyzes the integration of ATM into the overall multimodal transport system, considering currently available transportation modalities and the emerging transport and mobility forms envisaged for the next decades. Moreover, the X-TEAM D2D focuses on the detailed consideration of Concept of Operations (ConOps) for seamless D2D mobility in urban and extended urban areas (up to regional), understanding the risks and opportunities impacting strategic policy directions. Three time horizons are considered: baseline (2025), intermediate (2035) and final (2050).

The developed ConOps will be validated and evaluated against applicable Key Performance Areas (KPA) and Key Performance Indicators (KPI), using a simulation-based platform that considers the most relevant transport elements in the future, such as interfaces mode-mode, high-level network model, passenger-centric paradigm. Furthermore, specific use cases of the D2D journey under different scenarios will be identified. These use cases will be analyzed in depth to validate the ConOps and enable decision support tools.

2 Scientific and practical relevancy

X-TEAM D2D will bring the following improvements in the state-of-the-art research on the topic under study:

- Enhancing understanding of seamless D2D travel in integrated ATM and multimodal transport modes.
- Integrating modelling D2D travel into ATM and multimodal transport.

3 Materials and methods

The proposed research methodology comprises the definition and development of the ConOps, based on reference scenarios and application in use cases. The X-TEAM D2D ConOps for ATM integration into

multimodal transport describes the characteristics of the proposed system from the perspective of passengers and transport modes through several use cases. These case studies are developed to validate the proposed ConOps through simulation and modelling techniques.

The main specifications of the use cases include type, characteristics, profile and expected behaviour of different agents/passengers, new modes of transport that would be used for multimodal journey, the transport integration and data exchange that cover planning, management and resilience to disruptions and delays in the travel process. In total, 18 use cases were identified. Figure 1 gives an overview of the use cases and the disturbance occurrence.

Figure 1. Overview of the use cases within the time horizons

Time horizon	2025		2035		2050	
	Traveller		Traveller		Traveller	
Disturbance	Profile B	Profile V	Profile B	Profile V	Profile B	Profile V
no disturbance	B025	V025	B035	V035	B050	V050
5h prior to departure	B525	V525	B535	V535	B550	V550
ad hoc disturbance	Bd25	Vd25	Bd35	Vd35	Bd50	Vd50

 B: Business traveller  V: VFR - Visiting friends and relatives traveller

The definition of reference scenarios and their goals is based on an extensive literature review on ongoing global and regional economic trends, mobility and urban transport (travel mode attributes and traveller attribute), EC policy and long-term strategies in various areas, smart mobility in cities, and the impact of digitalization and automation on passenger's choice for transport mode and mobility. The summary of scenarios characteristics can be found in Table 1.

Table 1. Overview of reference scenarios definitions

Scenario 2025	<ul style="list-style-type: none"> - intensifying use of NMS (New Mobility Services) [1], emerging of CCAM (connected, cooperative, automated mobility) - further development of TEN-T (mainly rail and maritime) [2], shift to rail and maritime logistics - million public recharging stations and 500 hydrogen refuelling stations - Eurovignette
Scenario 2035	<ul style="list-style-type: none"> - emerging of UAM (Urban Air Mobility [3]), intensifying use of CCAM (connected, cooperative, automated mobility) - the Core TEN-T Network completed, smart pricing, shift to lower emission modes - 3 million public recharging stations and 1000 hydrogen refuelling stations - intensifying intermodality among the soft modes of travel, mass transit, NMS, CCAM
Scenario 2050	<ul style="list-style-type: none"> - net-zero emissions in transport - the Comprehensive TEN-T Network completed - walkable cities, domination of soft modes, mass transit, NMS, CCAM, UAM

The analysis of the potential integration of management systems of ATM and other modes with urban air mobility, aeronautical/vertical technologies, and surface transport technologies shows that most technologies will be partly achieved by 2035 (electric

vehicles, autonomous/electric bus in connection with the airport, transit elevated bus, autonomous car, shared electric micro-mobility) and fully deployed by 2050.

4 Modelling and validating ConOps

An important part of the X-TEAM D2D project is developing a simulation model for evaluating and validating the developed ConOps, according to three scenarios. Based on the simulation experiments results, a set of KPIs to measure the quality, sustainability, efficiency, and resilience of the ConOps is developed. The complete characteristics of the model and simulation experiments set up will be described in the full paper.

5 Results

In case of being accepted, we will present partial results of the D2D journey, which will provide insight into the X-TEAM approach potential and KPIs.

6 Conclusions and future development

For seamless integration of existing and future transport technologies into an overall multimodal network with a high level of passenger service, concepts of operations have to be developed and validated. These concepts will ensure the inclusiveness and resilience of the future transportation network for all types of passengers. To define and validate such operational concepts, the project XTEAM D2D performed an extensive technological review for three time horizons: 2025, 2035, and 2050. The ConOps are validated in simulation experiments and measuring different KPIs that describe the efficiency and passenger focus of the multimodal transportation network.

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