ASDA
Association for the Scientific Development of ATM in Europe

MODUS

Simulation Platform for Sustainable, Smart and Responsible Mobility

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French national Context

- Challenge 6 of the French national research priorities "Sustainable urbans transports and systems"
  - « **Cities and their transport infrastructures are complex systems, at the same time physical, economical, ecological, technical and societal. The search for balanced and sustainable solutions must therefore be multidisciplinary, involving not only technologies, new digital solutions and uses, sociology and economics, but also architecture, design, the study of behavior ...**»
  - 4 R&D priorities
    - **City observatory (digital twin)**
    - **New conceptions of mobility (autonomy, 3D, MaS…)**
    - **Tools and technologies at the service of the sustainable city (IoT, AI, open data, Galileo, satellites, UAM…)**
    - **Integration and resilience of infrastructure and urban networks (inter-modality, crisis situations are no longer the exception but the rule)**
- **Strong societal stakes and expectations.**
- **Need for inter-disciplinary hubs of research on sustainable transport**

SESAR Context

- SESAR 3 Topic 4 « U-space and UAM », Needs: "U-space performance framework" and "Safety assurance"
  - « **Leverage extensive modelling, simulation and experimentation to assess the maturity and interoperability of U-space services**, assess different deployment options and support their industrialization and deployment. Create U-space test centers… such centers can also support the certification of new U-space service providers…**making it possible to increase flexibility for rapid and agile increments of the U-space ecosystem** »
- SESAR 3 Topic 6: "Multimodality and passenger experience". Needs: "Integrated transport performance cockpit" and "integrated transport network crisis management process"
  - « **Data from various sources, aligned with powerful analytics, will allow the creation of database services supporting journey optimization and personalization of offers to customers** »
  - « Recent events (e.g. terrorist attacks) demonstrated **the need to coordinate – when managing a crisis between different modes of transport and a multitude of actors**, including local and national authorities' representatives to increase overall transport system resilience and provide a better service to the customers. »

Simulation: a must for MMS

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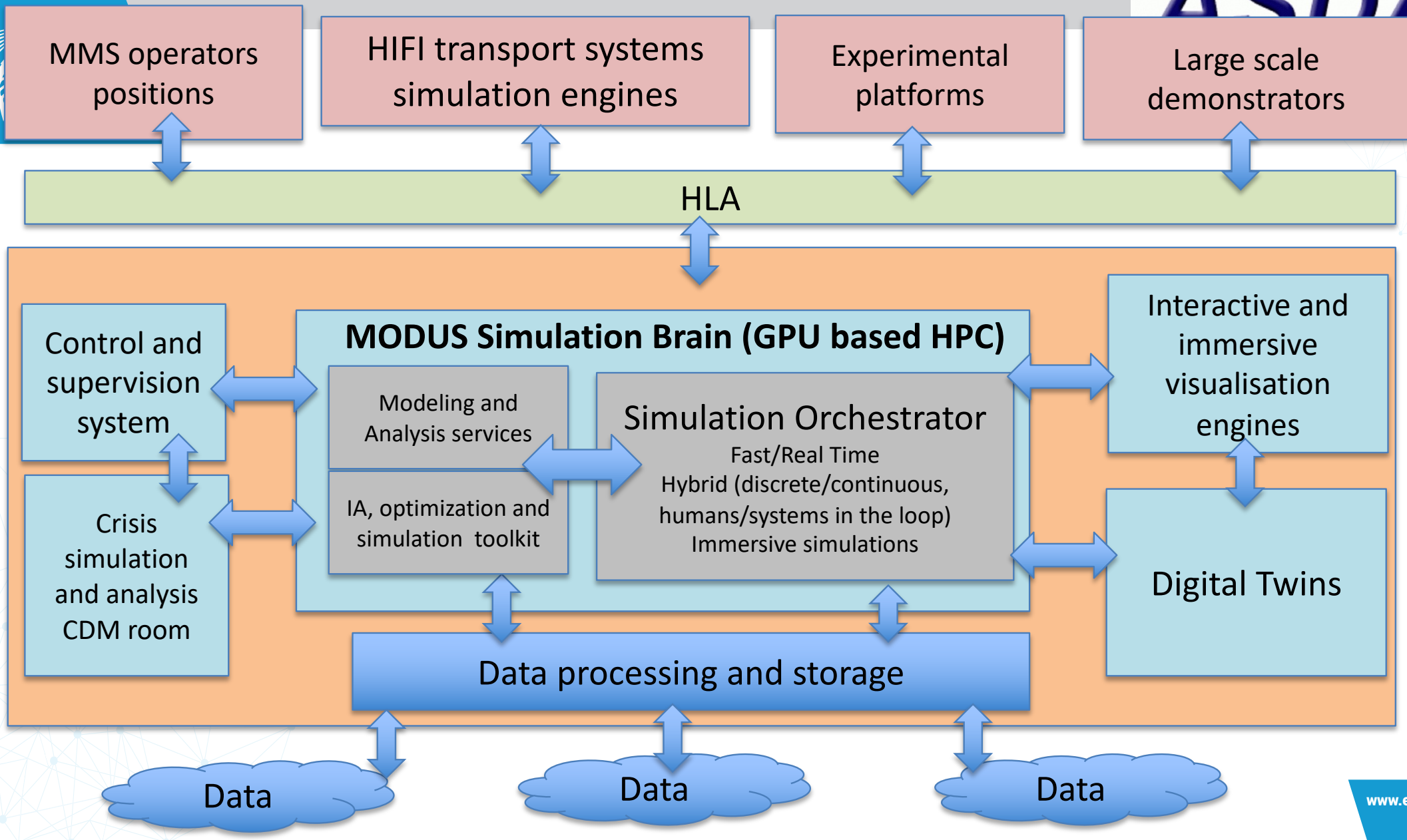
- MMS are too complex and subject to too many random and unknown issues and events to base their design on analytical formal modeling and analysis only.
- The simulation of complex systems, such as MultiModal Transport Systems (MMTS) is a necessary step before design and deployment.
- Strong needs for widely agreed and used datasets and performance analysis benchmarks for the assessment of performance KPI and cockpits for MMTS (a clear lack for our community).
- Need for holistic simulation platforms aimed at developing sustainable, responsible and acceptable transport systems submitted to sound irrepressible tendencies:
  - Envisioned paradigm shift: from "No passenger operations" to "user centric operations"
  - Need and expectation to define the right place of air transport into a D2D chain of sustainable modalities of mobility and to assess the sustainability of new emerging transport services.
  - The mantra of autonomy: Towards Autonomy and beyond?:
    - What are the limits for airspace management and transport autonomy level 5 ?
    - Which roles for human operators: engineering, supervision, hypervision, maintenance…?
    - How far these limits can push forward the walls of capacity, adaptability, security, cost?

Simulation Outcomes

- Contribute to the **analysis and validation of** new sustainable and user centric transport services (role and place of AI, identification and evaluation of KPIs, performance cockpit…)
- **Federate all stakeholders around a holistic modeling/simulation platform** (operators, laboratories, users, etc.)
- **Validate scenarios prior to their experimentation** (reduction of time and costs, early involvement of users)
- Analyze the impact of solutions envisaged based on **"What if" type analysis** based on digital twins
- Make it possible **large** population, temporal (day, week, month…) and spatial (city, region, nation…) **scales simulations**
- Anticipate changes and service degradation or disruption, understand why and propose solutions before the emergence of problems (enforce MMS resilience)
- Prepare for crisis situations by applying CDM scenarios in response to crisis situations simulations
- Validate mobility solutions that meet regional, national and European societal challenges: an ultimate tool to study the limits of the "No passenger operations" to "user centric operations" paradigm shift.


MMS operators positions
HIFI transport systems simulation engines
Experimental platforms
Large scale demonstrators
HLA
Control and supervision system
Crisis simulation and analysis CDM room
MODUS Simulation Brain (GPU based HPC)
Modeling and Analysis services
IA, optimization and simulation toolkit
Simulation Orchestrator
Fast/Real Time
Hybrid (discrete/continuous, humans/systems in the loop)
Immersive simulations
Interactive and immersive visualisation engines
Digital Twins
Data processing and storage
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