TWINLOOP

Open Framework for Software Defined EVs

Co-funded by
the European Union

TWIN-LOOP AT A GLANCE

MAIN GOAL

TWIN-LOOP will develop an Open Framework for TwinOps for EVs and a suite of digital tools for continuous improvement of Energy Consumption reduction, Hardware Costs minimization, Driver Experience and Vehicle Resiliency across the 4 stages of vehicle lifecycle. The TwinOps concept is the combination of Digital Twins over a continuous integration/deployment production cycle (DevSecOps) and it leverages other sources of truth (e.g., CAD, Physics) to improve SW Verification and Validation (V&V), using precise models instead of (naive) abstractions. The specificity of each EV is taken in account (MyEV concept) in order to improve each stage, from design to validation in an infinite loop.

KEY FACTS

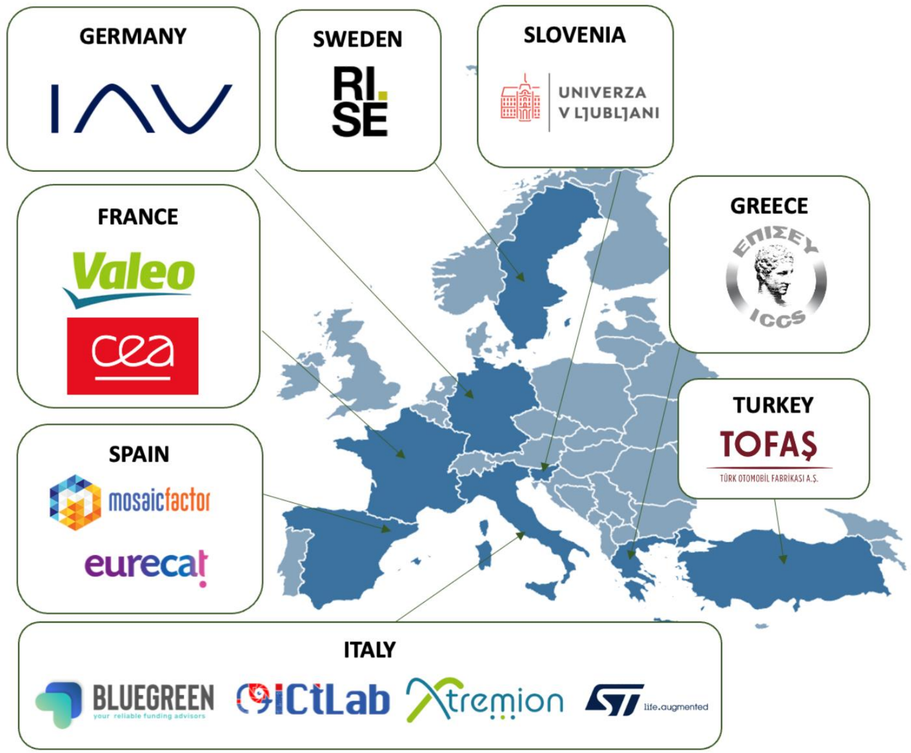
RUN TIME

January 2025 – December 2027

BUDGET

5 M€

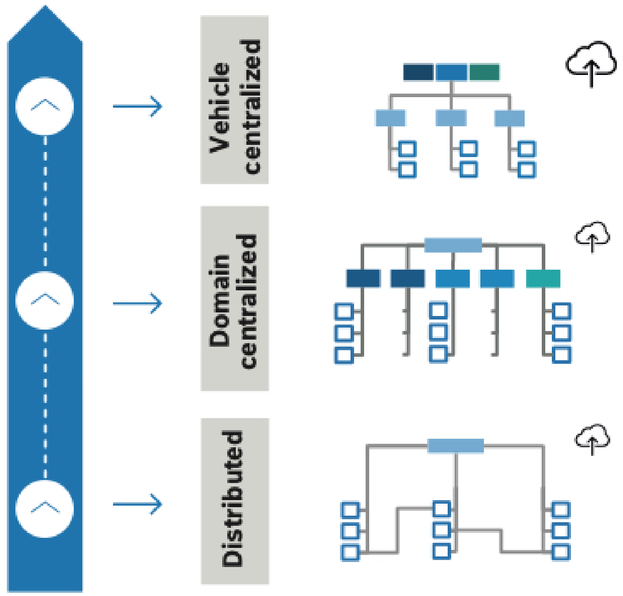
CONSORTIUM



MOTIVATIONS

SDVoF

- Security
- Trustworthiness
- Cost reduction
- User-centric perspective
- Computational capacity
- OTA updates



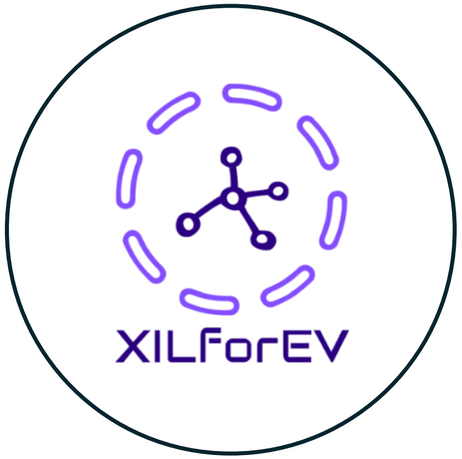
Picture source: The next step in E/E architectures. Whitepaper, BOSCH, 2024.

ELECTRIC VEHICLES

- Reducing energy consumption while increasing safety
- Competing more effectively with traditional vehicles
- Enhancing the EV driving experience

WHERE DO WE COME FROM?

PREVIOUS PROJECTS



Apply their innovative techniques for connecting experimental labs in the development of the TWIN-LOOP' DTs for EVs

Keep TWINLOOP aligned with FEDERATE's road-map, and to become part of the SDV collaborative community that is being forged within Europe

Battery models and AI applications developed will be used as a reference in TWIN-LOOP

Taken as a reference in V&V techniques, Runtime Verification and cybersecurity

WHAT WILL TWIN-LOOP DO?

OBJECTIVE 1

Develop and validate an Open Framework for MyEV Digital Twins and AI EV specific APPS based on physics and data-driven models that allows an efficient, continuous and reliable upgrade of software-defined electric vehicle functions

OBJECTIVE 2

Provide a methodology and digital tools for minimizing design, development, validation and operational costs and making possible fast time-to-market of complex electric vehicles using the TwinOps concept

OBJECTIVE 3

Design and implement a cybersecurity framework that considers the drivers habits, needs and preferences for a trustworthy and resilient electric vehicle

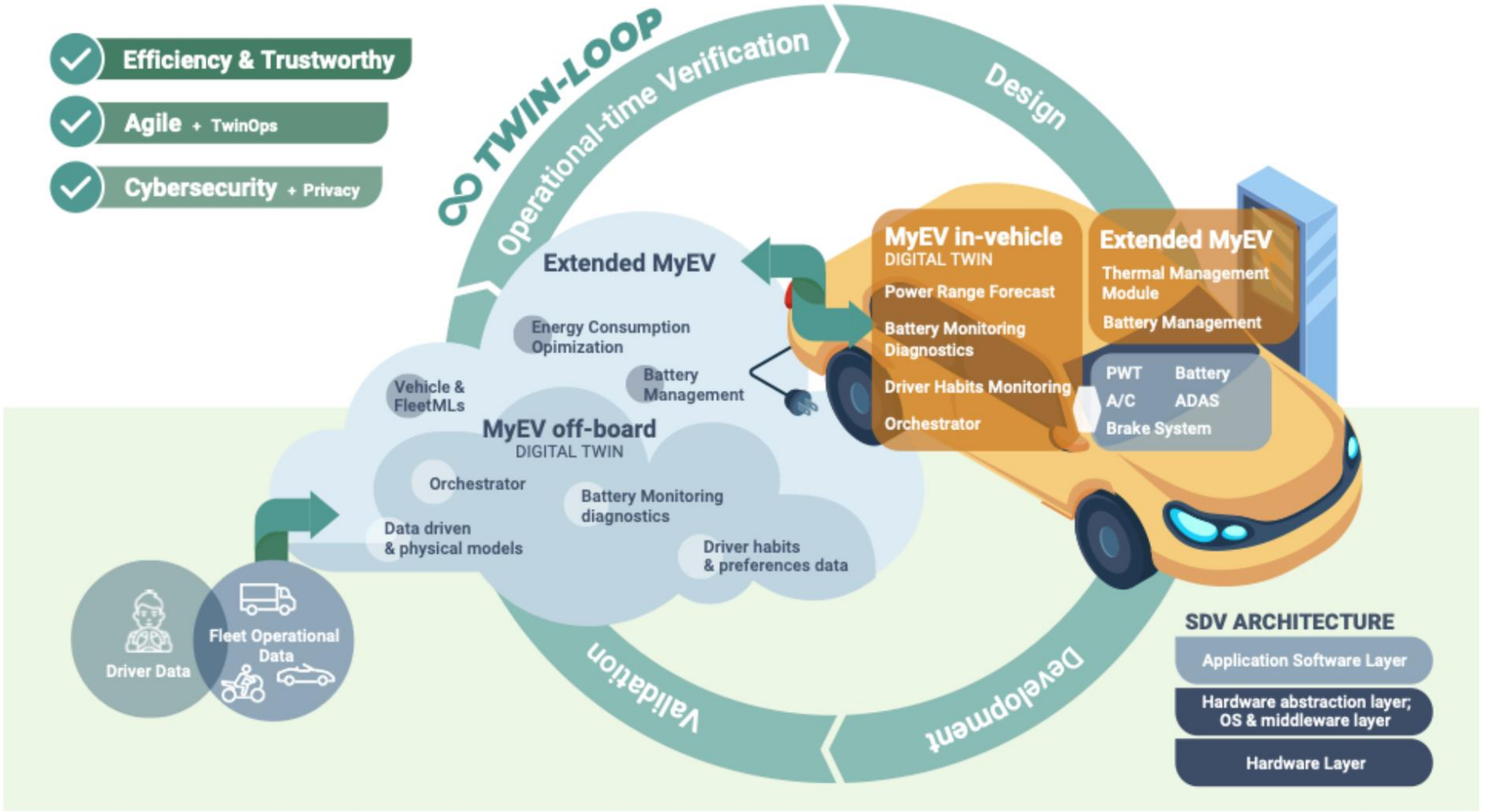
OBJECTIVE 4

Assess the benefits and impact of TWIN-LOOP methodologies and digital tools

OBJECTIVE 5

Disseminate and communicate TWIN-LOOP findings to 2ZERO stakeholders in EU and beyond, liaise with EU type approval authorities and relevant UNECE working groups and promote project results to standardisation

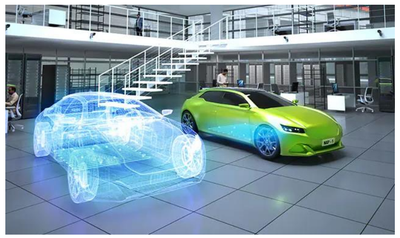
METHODOLOGY



USE CASES

INTEGRATED AND HOLISTIC EV DIGITAL TWIN

- Open Framework for development of MyEV Digital Twins
- Physical and data driven models dynamic management
- TWIN-LOOP application for energy consumption reduction
- TWIN-LOOP application for more accurate power range forecast
- TWIN-LOOP design optimisation based on individual vehicle and fleet data



ENHANCED POWER RANGE FORECAST BASED ON ROAD/DRIVER PROFILING

- Driver/road profiling database based on driving data from consortium and external databases
- Battery health monitoring application
- Enhanced power range forecast application
- Custom driving behavior suggestions via in-built interfaces

CYBERSECURE AND RESILIENT SOFTWARE DEFINED EVs

- Secure Design
- Interface and Communications Protection
- Secure OTA updates
- Continuous Monitoring

TWIN-LOOP and FEDERATE

- COMMON DISSEMINATION – AMPLIFIED RESONANCE
- VISIBILITY INSIDE THE DIFFERENT CONSORTIUMS – WIDE PERSPECTIVE
- COLLABORATION WITH MEMBERS OF THE PROJECTS (OEMS AND TIER-1 SUPPLIERS)- EXPERT SINERGIES
- EVALUATE USE OF FEDERATE BUILDING BLOCKS IN TWIN-LOOP
- PUBLICATION OF TWIN-LOOP OPEN FRAMEWORK IN FEDERATE CATALOGUE

OPEN FRAMEWORK FOR SDEVs

Open Framework for TwinOps and Digital Tools for EVs

The open framework is a public set of tools, components, and rules that makes it easier and faster to develop Digital Twins for EV.

It offers reusable parts, guidelines, and sometimes common services, so you don't have to build everything from scratch.

The tangible part includes things you can directly use: framework specification, code libraries, templates, APIs, practical examples and clear documentation.

Technical Documentation

Framework Specification

Modules Implementation

OPEN FRAMEWORK FOR Digital Twins

FEATURES

Provides a predefined structure to organize and build applications efficiently

Promotes reusability of components, reducing development time and effort

Allows customization and extension to meet specific project needs

OPEN FRAMEWORK FOR Digital Twins

USERS

User Group	Roles and Expected Interactions with the Framework
OEMs and Tier-1 Suppliers	• Integrate the framework into vehicle platforms for lifecycle data and real-time monitoring • Customize or extend digital twin modules (e.g., battery, thermal) • Support DevOps/TwinOps workflows within development pipelines
Software Developers and System Integrators	• Develop and plug in custom applications and services (e.g., AI-based forecasting) • Implement vertical integration across in-vehicle and cloud components • Contribute to the evolution of shared modules and interfaces
Research and Innovation Entities	• Evaluate experimental DT algorithms and concepts • Benchmark modularity, scalability, and interoperability • Contribute to open standards and methodologies for digital twins

OPEN FRAMEWORK- BENEFITS

BENEFITS ALIGNED WITH FEDERATE OBJECIVE

FLEXIBILITY

Provides the adaptability to customize and modify components, fitting diverse project requirements

COLLABORATION

It allows teamwork and shared development efforts between companies by enabling contributions from a global community

ESCALABILITY

Open frameworks grow seamlessly with project demands. Are designed to expand and handle increasing complexity

INNOVATION

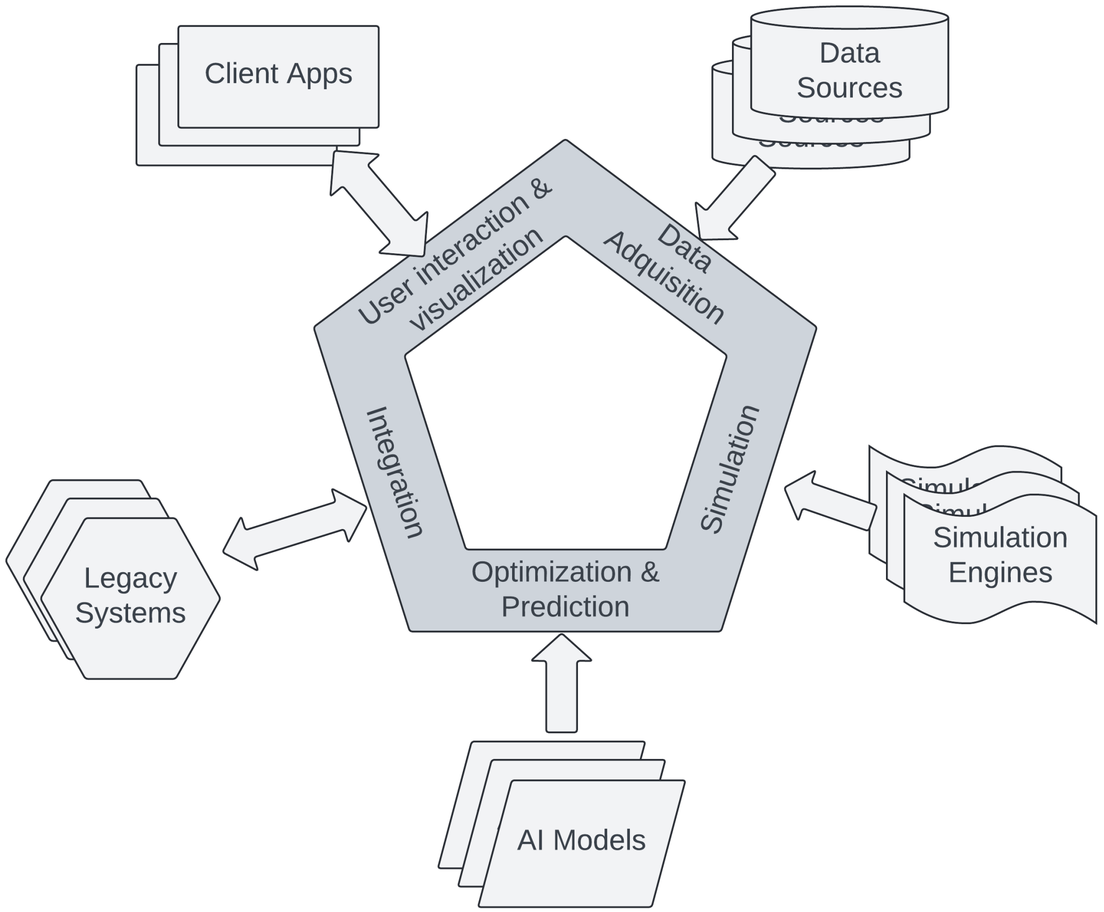
They empower developers to explore and implement new ideas based on shared technology and by giving full access to the system's core

01 Objective

Collect and evaluate future trends (automated driving, V2X, EdgeAI at the SDV and the connected infrastructure) to predict SDV related ones and derive high-level requirements for stakeholders (industry, government, research and community) and to deduce definitions of common non-differentiating building blocks (software components, containers, SDKs, services, ...) that are reusable and scalable across departments and companies, taking into account already existing high-level requirements from the stakeholders and those already worked out in the sherpa group meetings.

REAL WORLD INTEGRATION

INTERACTION WITH EXTERNAL SYSTEMS



USER INTERACTION

User interaction and visualization from client apps

DATA ADQUISITION

Data acquisition from external data sources

SIMULATION

Simulation of real and what if scenarios

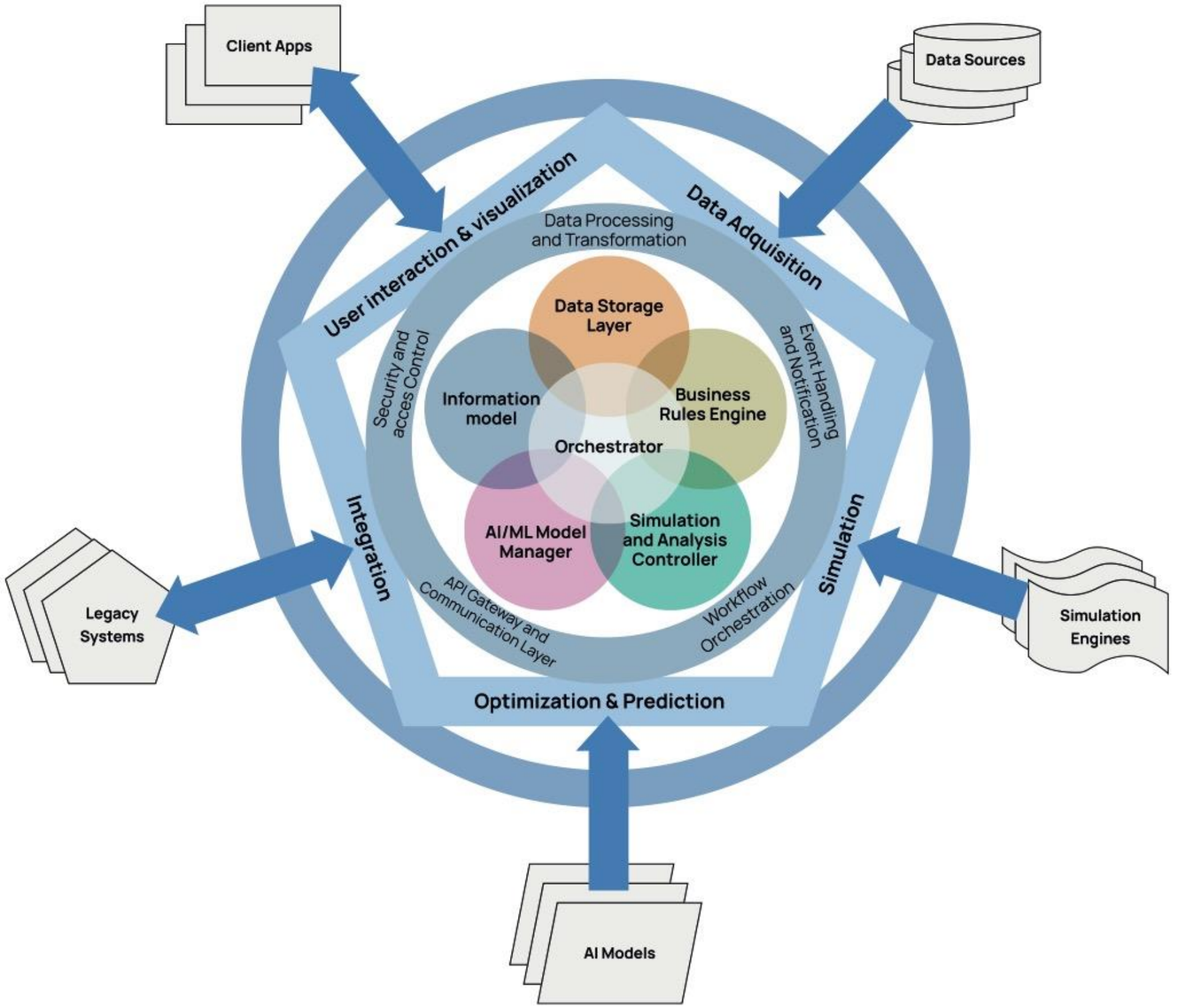
MODELLING

Optimization and Prediction modelling based on real data

INTEGRATION

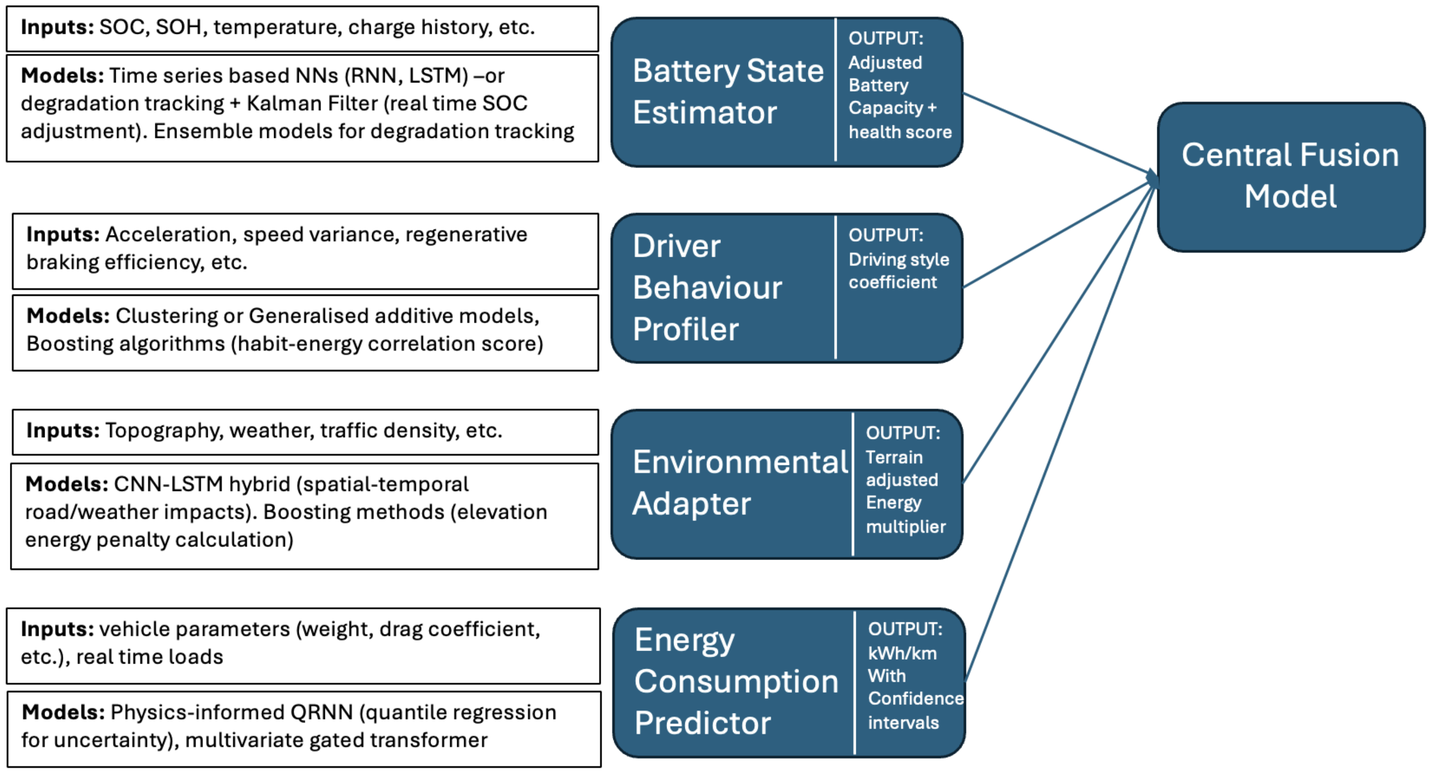
Integration with Legacy systems for real-time interaction with the real environment

REFERENCE ARCHITECTURE



ENERGY & RANGE FORESCASTING APP

INNOVATION APP USE CASE STUDY



TWINLOOP

THANK YOU!

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