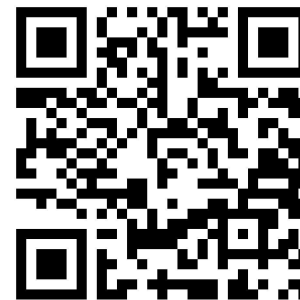


IoV-TwinChain: Predictive Maintenance of Vehicles in Internet of Vehicles through Digital Twin and Blockchain

Mubashar Iqbal, Raimundas Matulevičius, Faiz Ali Shah
Sabah Suhail, Kieran McLaughlin, Saif Ur Rehman Malik



<https://doi.org/10.1016/j.iot.2025.101514>



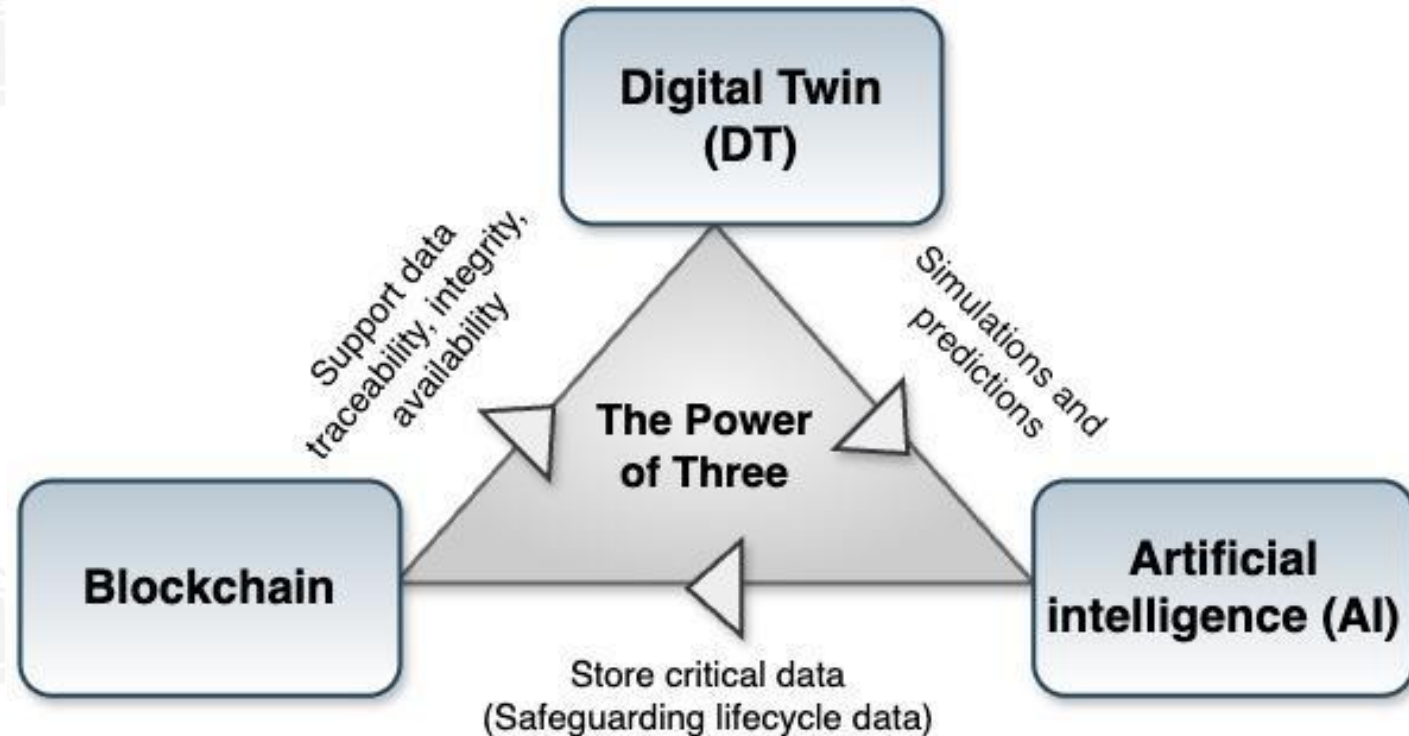
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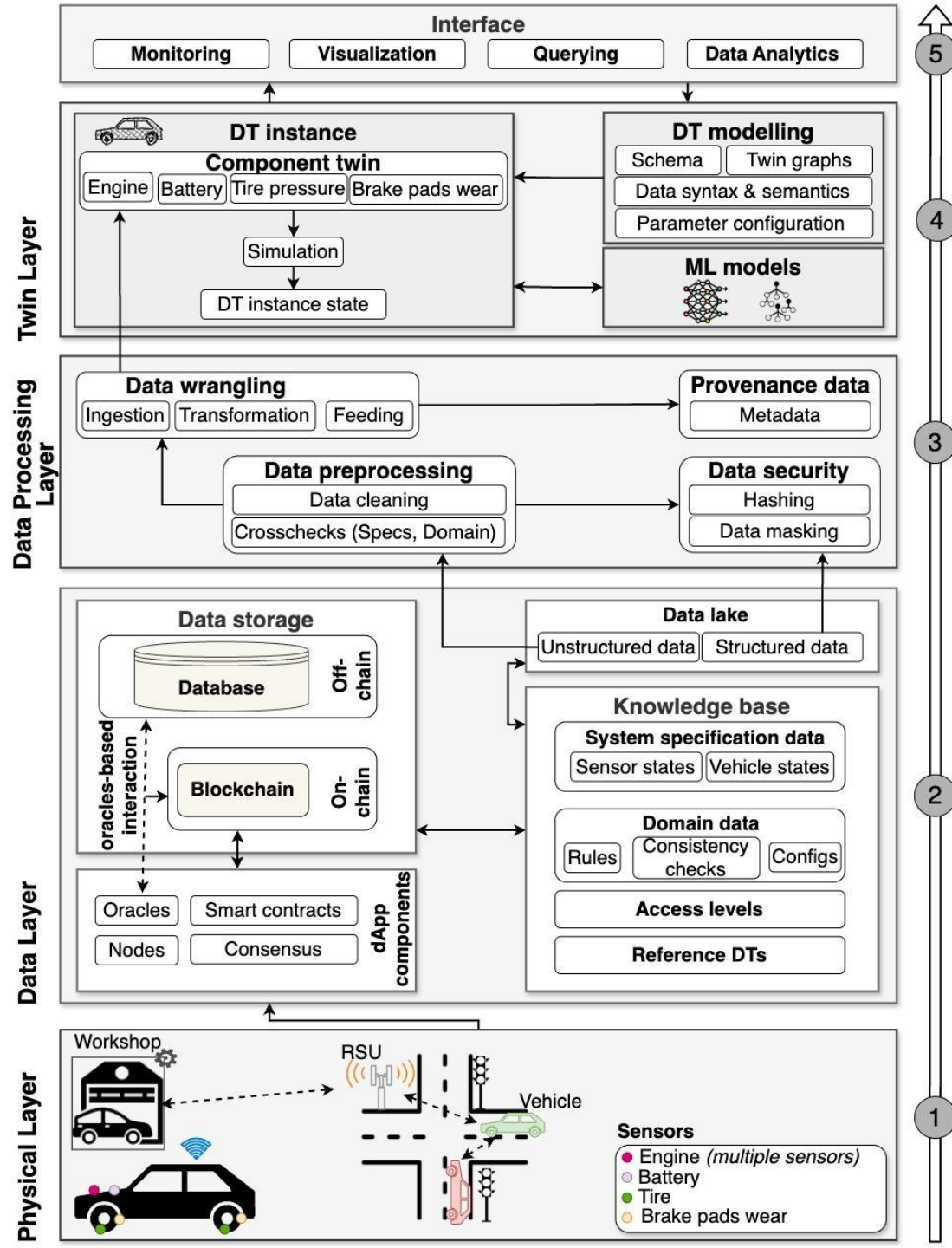


Predictive Maintenance of Vehicles



Leveraging the Power of Three



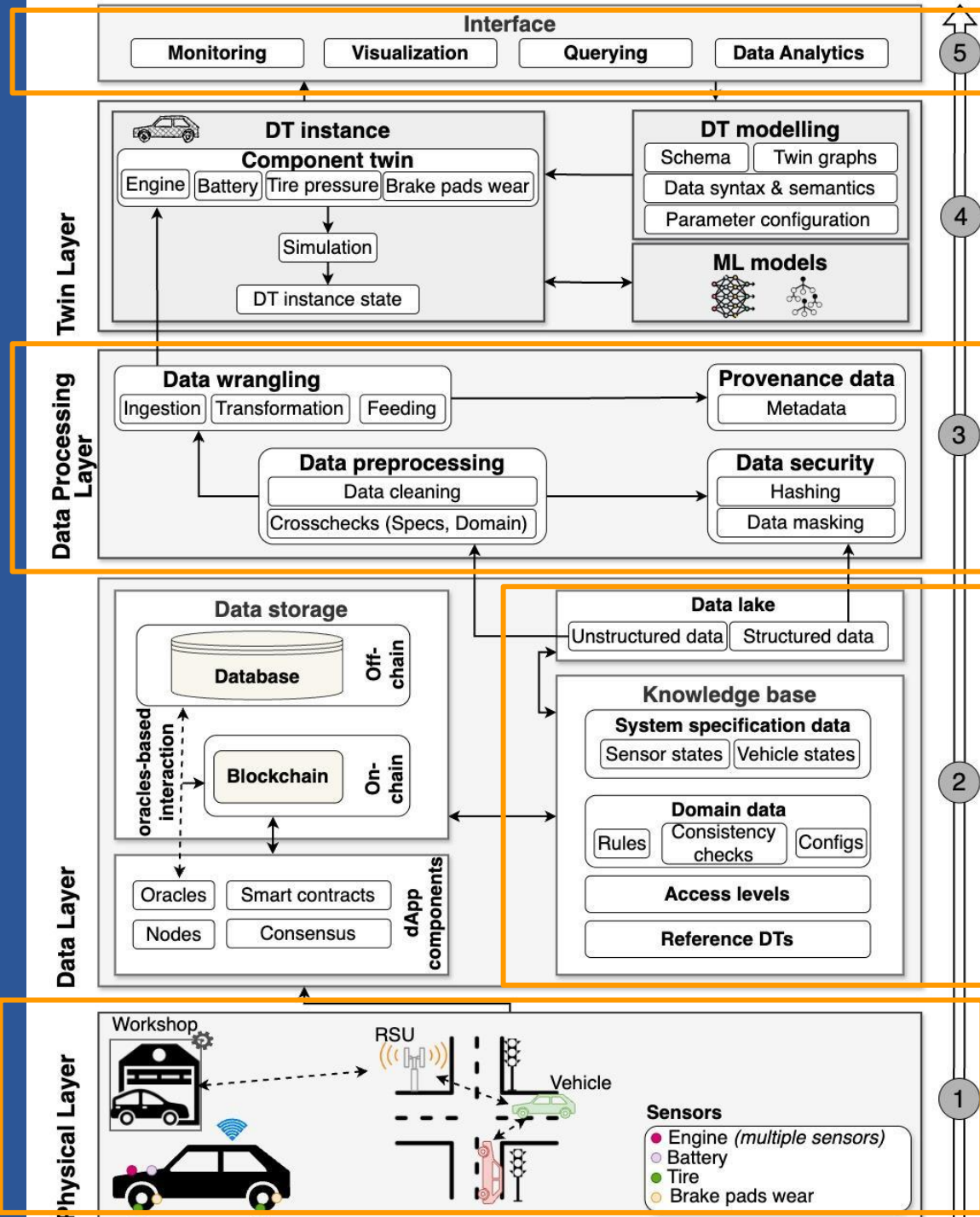


IoV-TwinChain Framework

- Physical layer
- Data layer
- Data processing layer
- Twin layer
- Interface

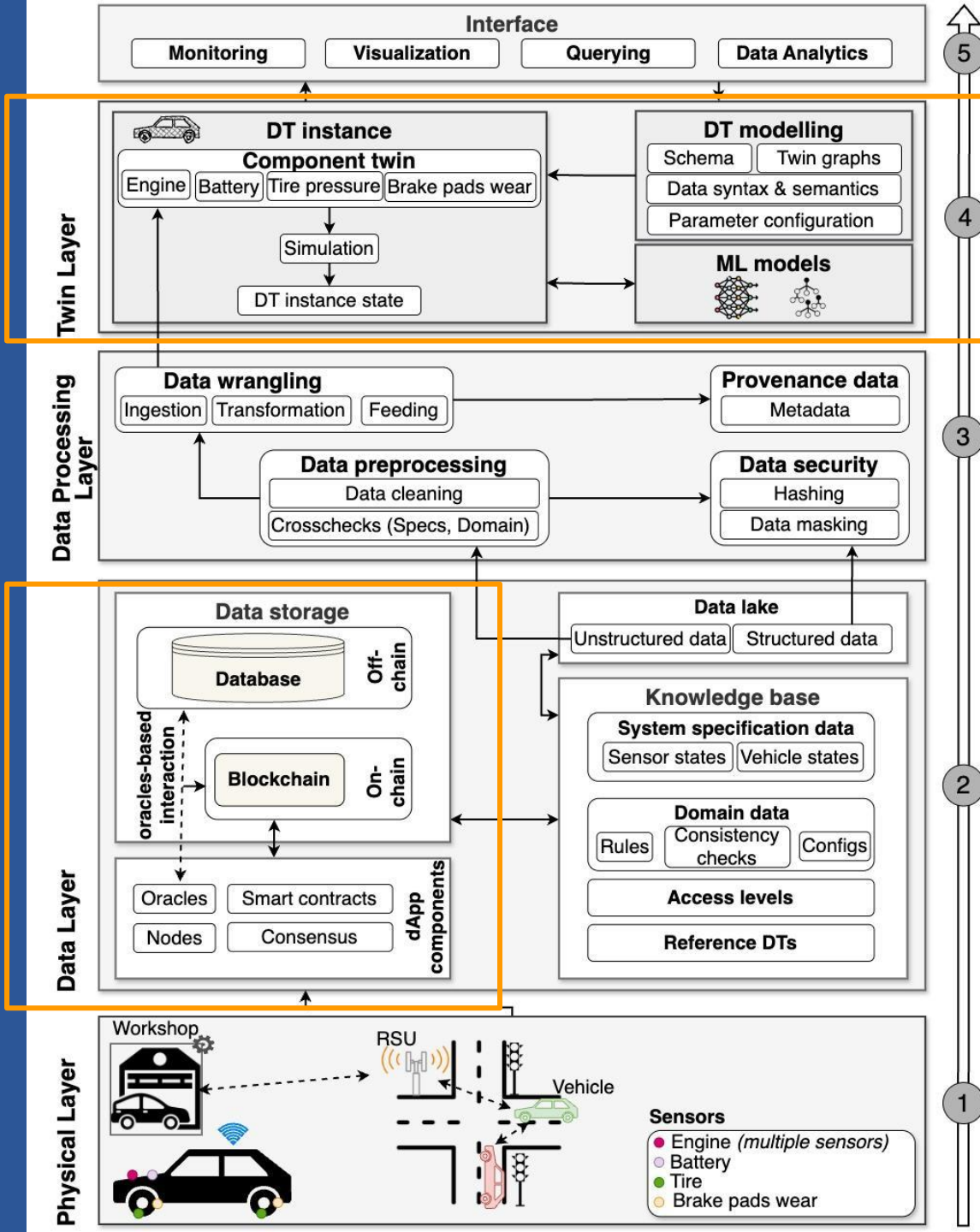
IoV-TwinChain Framework

- *Physical layer*
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- *Data processing layer*
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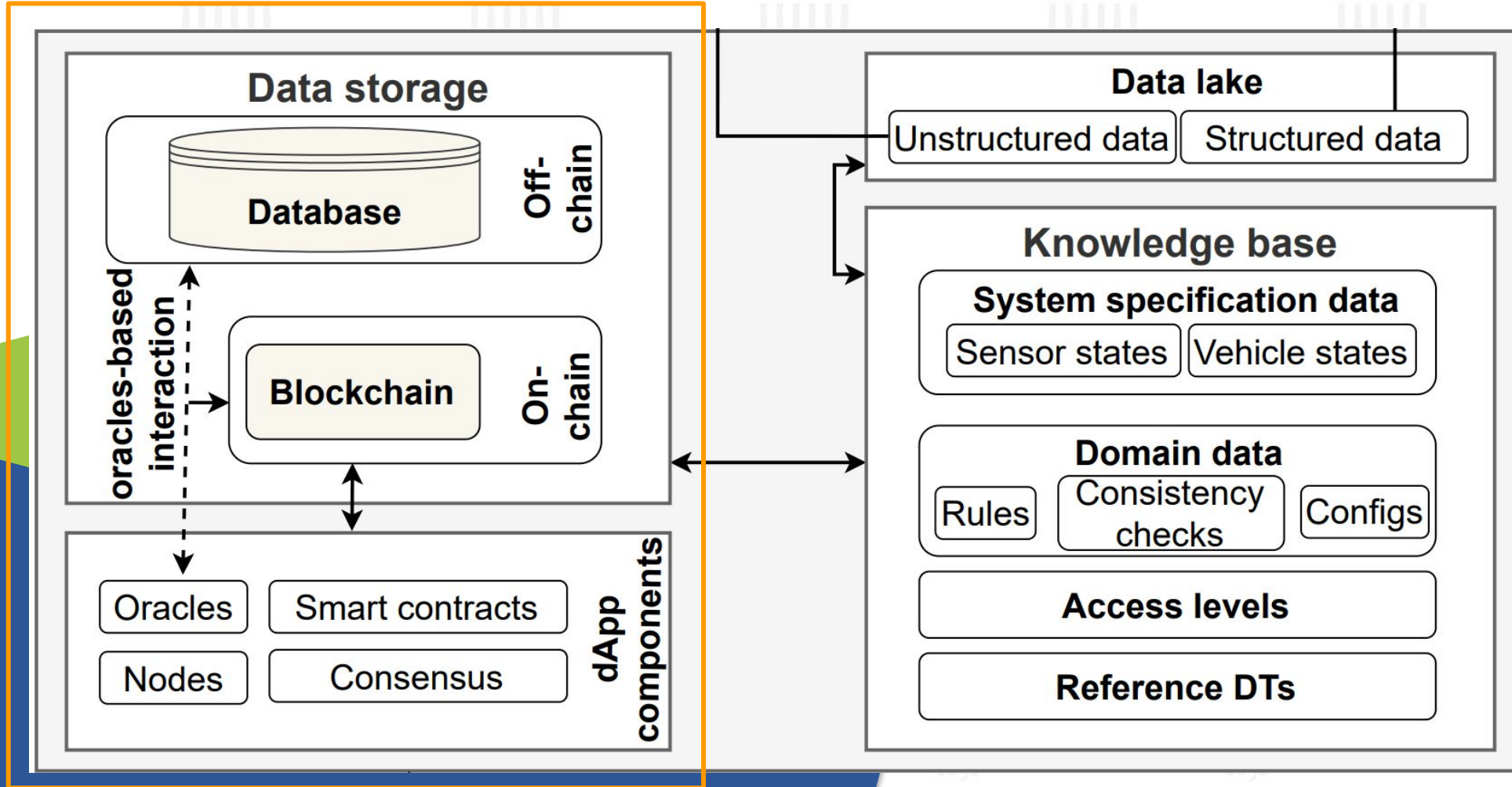


IoV-TwinChain Framework

- *Physical layer*
- *Data layer*
- *Data processing layer*
- *Twin layer*
- *Interface*

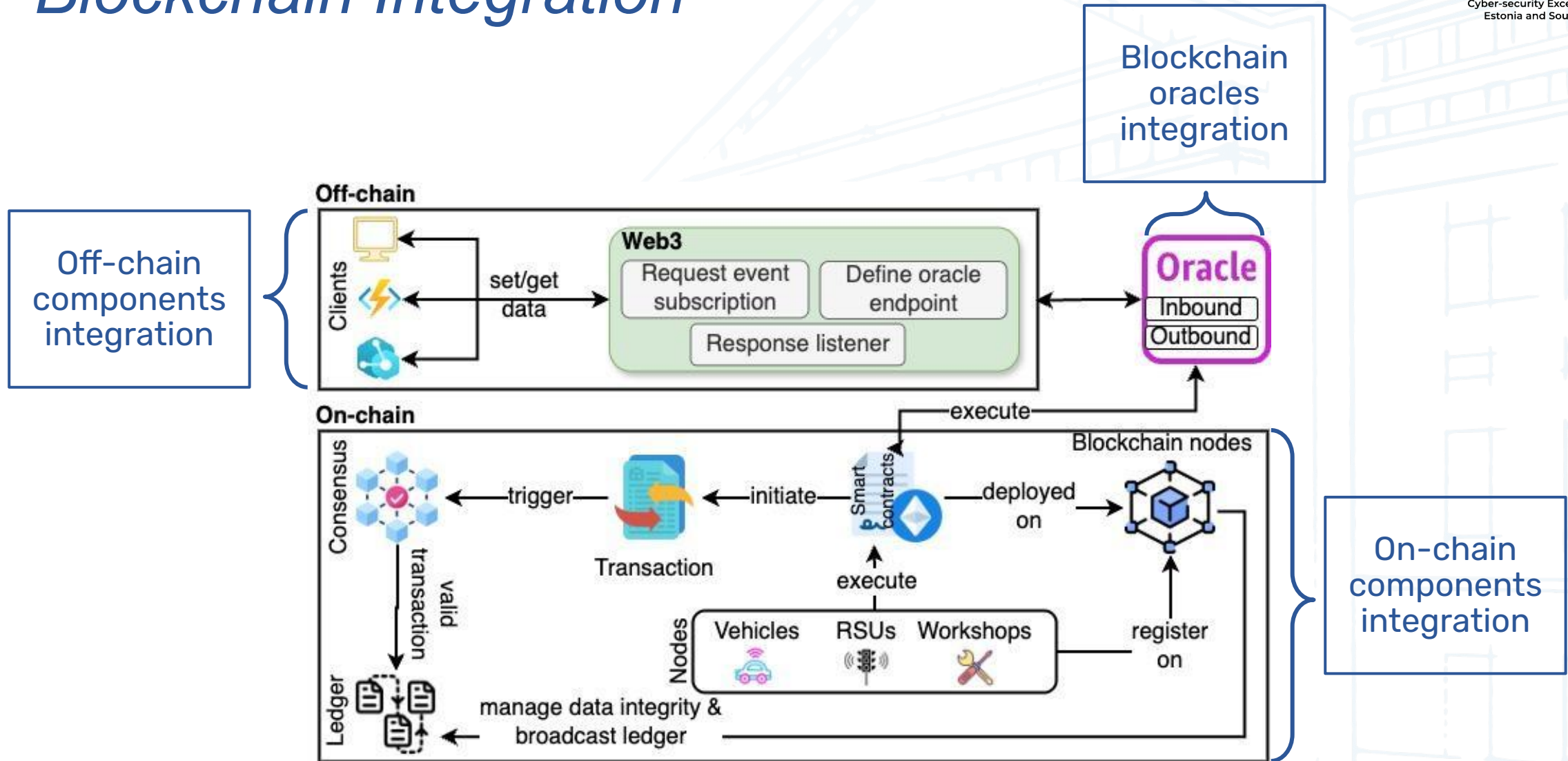


Historical and real-time sensory data

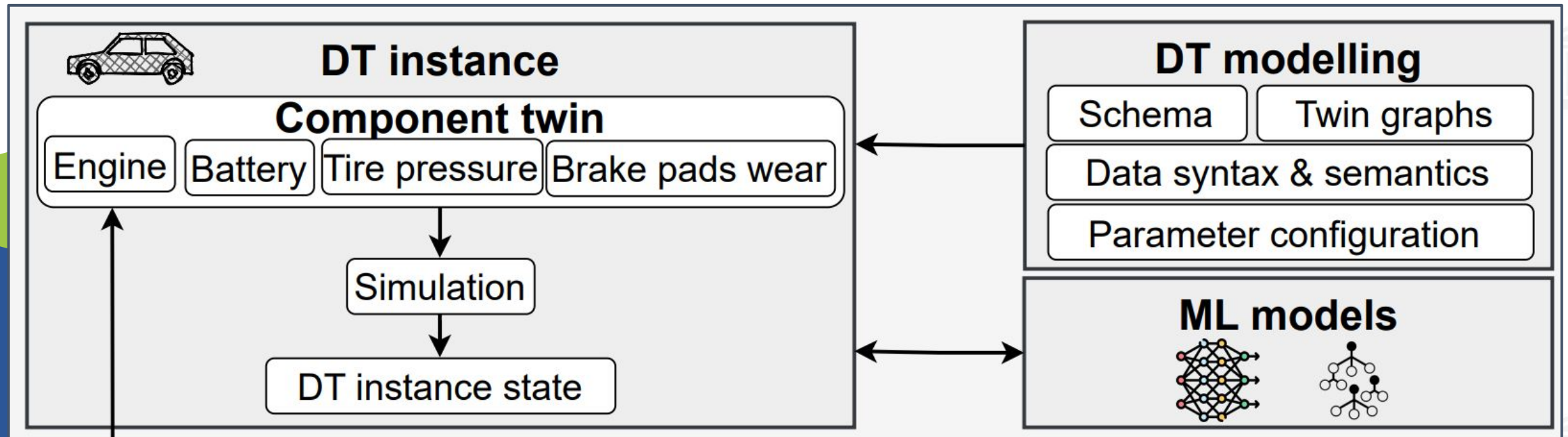


Data Layer

Blockchain Integration

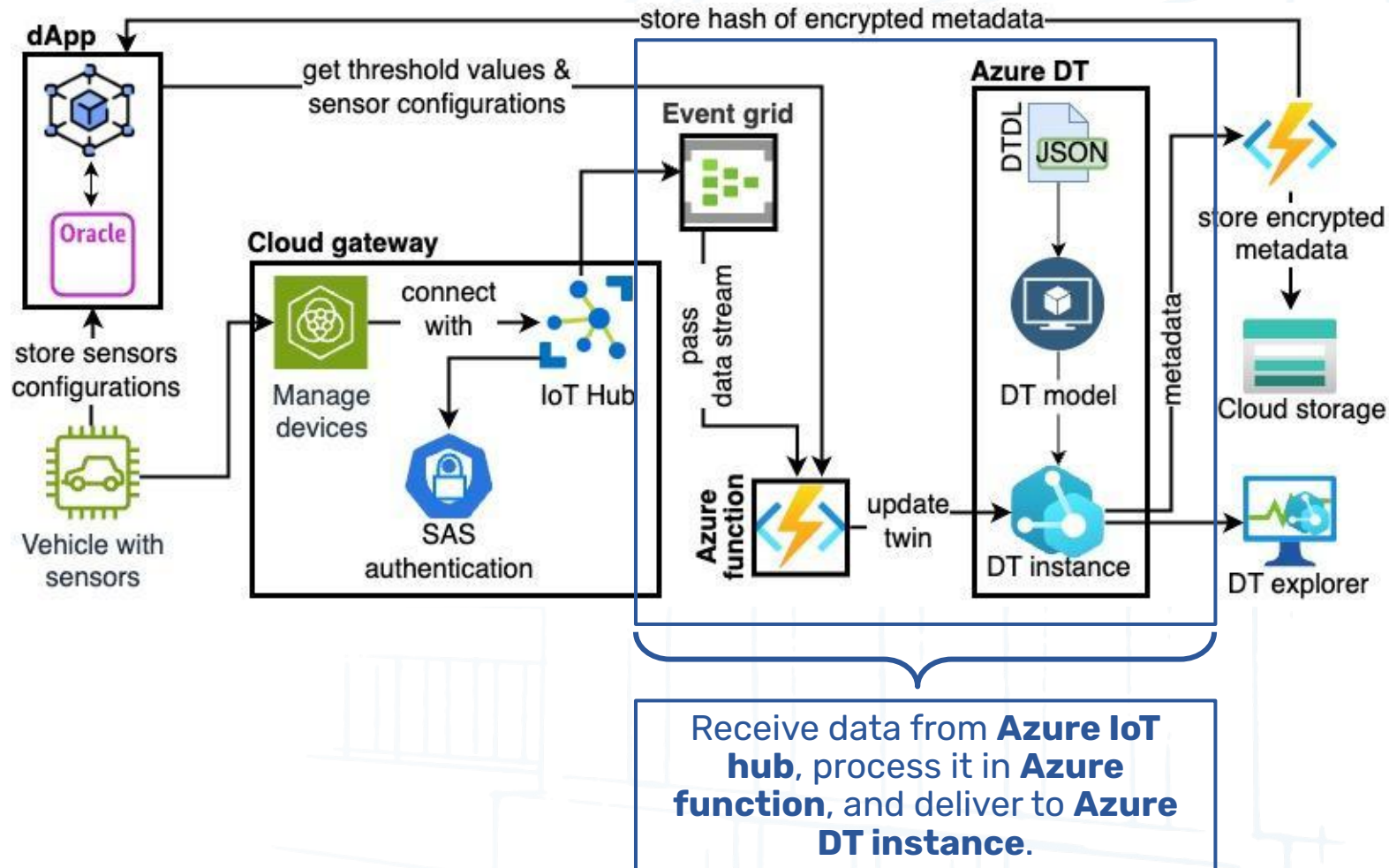


DT instance modeling following composable DT-based modular approach



Twin Layer

DT Modeling and Development using Microsoft Azure DT



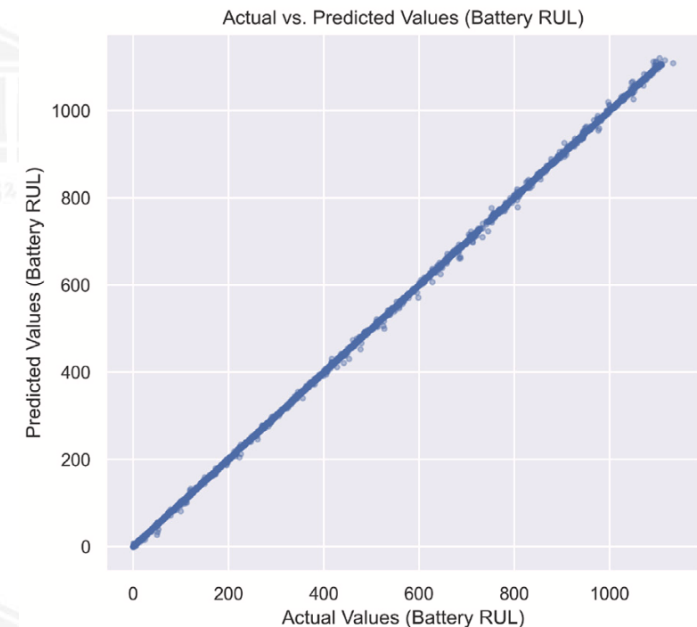
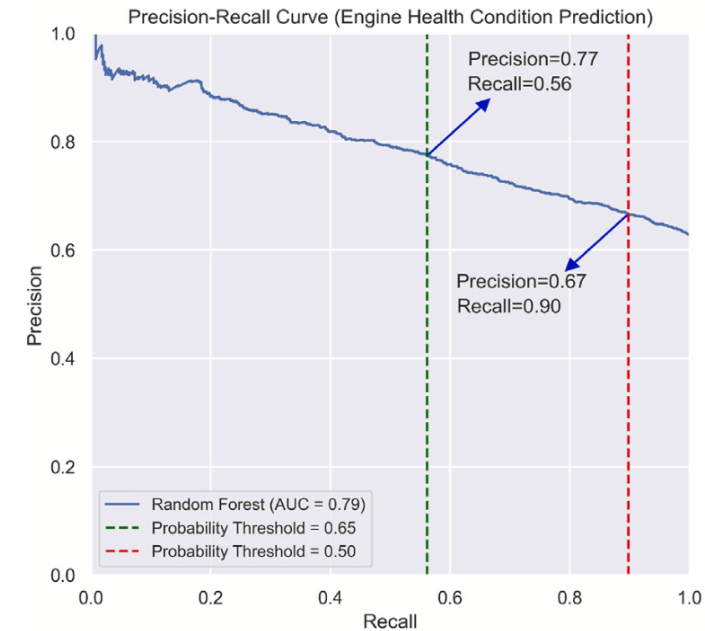
ML models

- *Random Forest*
- *eXtreme Gradient Boosting (Xgboost)*

Datasets

- *The **engine health dataset**, comprises 19,535 labelled examples*
- *The **vehicle batteries remaining useful life dataset** comprises 5,064 labelled examples*

AI integration



Highlights

IoV-TwinChain enhances road safety by proactively monitoring vehicle operating conditions

Digital Twin enables real-time monitoring and simulation of vehicle operating conditions

Machine learning facilitates data-driven predictions for vehicle predictive maintenance

Blockchain guarantees data integrity and traceability across the physical vehicle and its twin





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