

COUPLING OF A MULTI-ECU HiL SYSTEM WITH A DiL

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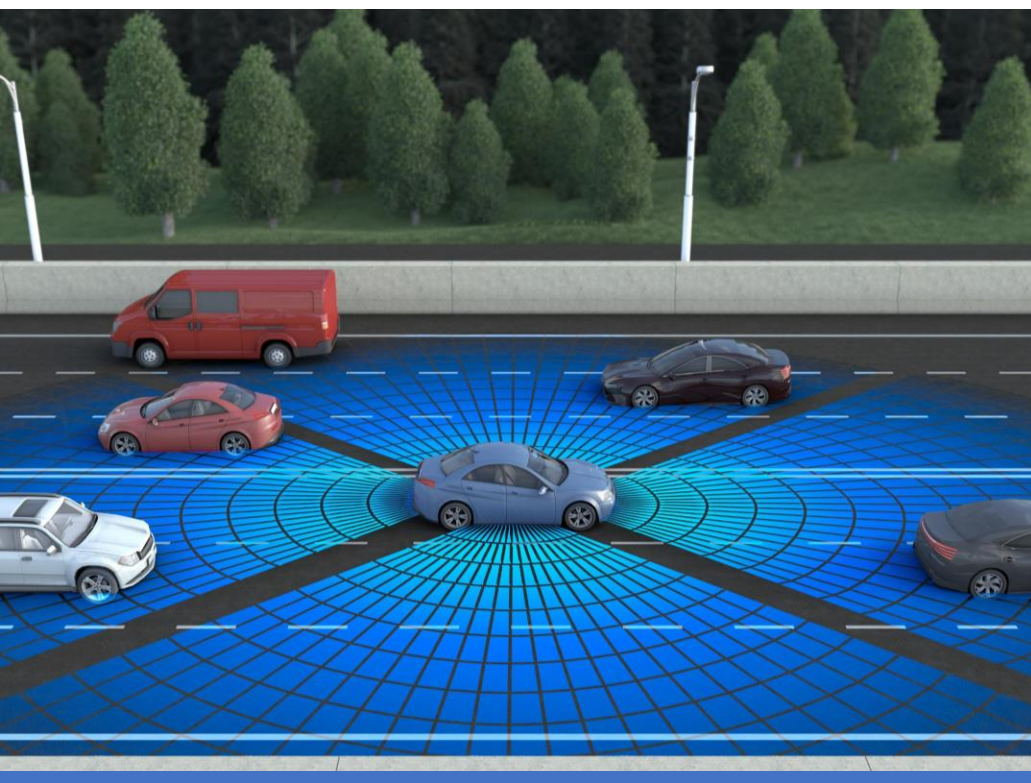
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RSEngineering

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VI-grade Technology: Challenges, Solution and Value



- The Challenges: Developing a modular simulation model to support XiL Development, Longitudinal Drivability HiL, Coupling with Powertrain Rig (HiL+DiL)
- The Solution: Implementation of VI-grade Technology for MiL-HiL-DiL, Combined drivability HiL, Connection to DiL and PWT RIG - DiL CONNECTION
- The Value: Ability to test ECUs in a highly controlled and repeatable environment, early detection of System defects (Software Bugs), Opportunity for Baseline Tuning even before starting Vehicle Testing, Functional Safety Concept development and Verification, More robust debugging and validation adding the human factor, and possibility to capitalize the experience of vehicle testers

RIMAC GROUP

Our Story



MAKING OF BUGATTI RIMAC

COMBINING THE MOST ICONIC HYPERCAR BRAND WITH THE BEST EV TECHNOLOGY

BUGATTI AUTOMOBILES

CREATION OF A NEW
SEGMENT IN THE
AUTOMOTIVE INDUSTRY



SETTING NEW
BENCHMARKS FOR THE
BEST OF THE BEST



110 YEAR
HISTORY



+

RIMAC AUTOMOBILI

FIRST ALL-ELECTRIC
HYPERCAR



WORLD'S FASTEST
ACCELERATING HYPERCAR
1,900+hp EV PLATFORM



TECHNOLOGY PARTNER
TO GLOBAL AUTOMOTIVE
MANUFACTURERS

RIMAC GROUP

SHAREHOLDER STRUCTURE

MATE RIMAC PORSCHE SOFTBANK INVESTINDUSTRIAL HYUNDAI GOLDMAN SACHS OTHER INVESTORS

45%

55%

100%

RIMAC GROUP

BUGATTI RIMAC

RIMAC TECHNOLOGY

BUGATTI AUTOMOBILES

RIMAC AUTOMOBILI

RIMAC LOCATIONS ACROSS EUROPE



WARWICK (UK)



BERLIN (GERMANY)



MOLSHEIM (FRANCE)



ZAGREB & SVETA NEDELJA (CROATIA)

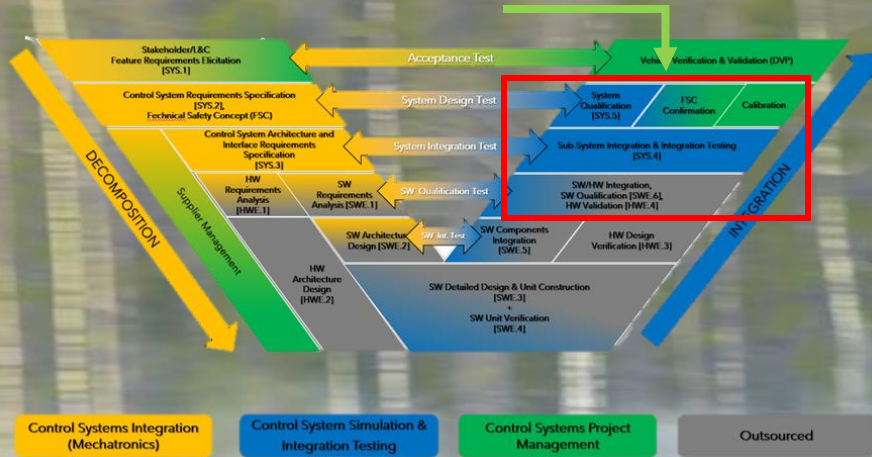


OSIJEK (CROATIA)



SPLIT (CROATIA)

Vehicle Controls Development



Motivation:

- Cost
- Timing
- Quality and Risk



Benefits:

- ECUs can be tested in a highly controlled and repeatable environment
- System defects (Software Bugs) can be detected early on in the development process with significant ROI
- Ability to simulate a wide range of scenarios, such as extreme conditions, road surface changes, system malfunctions
- Opportunity for Baseline Tuning even before starting Vehicle Testing
- Functional Safety Concept development and Verification

RSE – WHO WE ARE



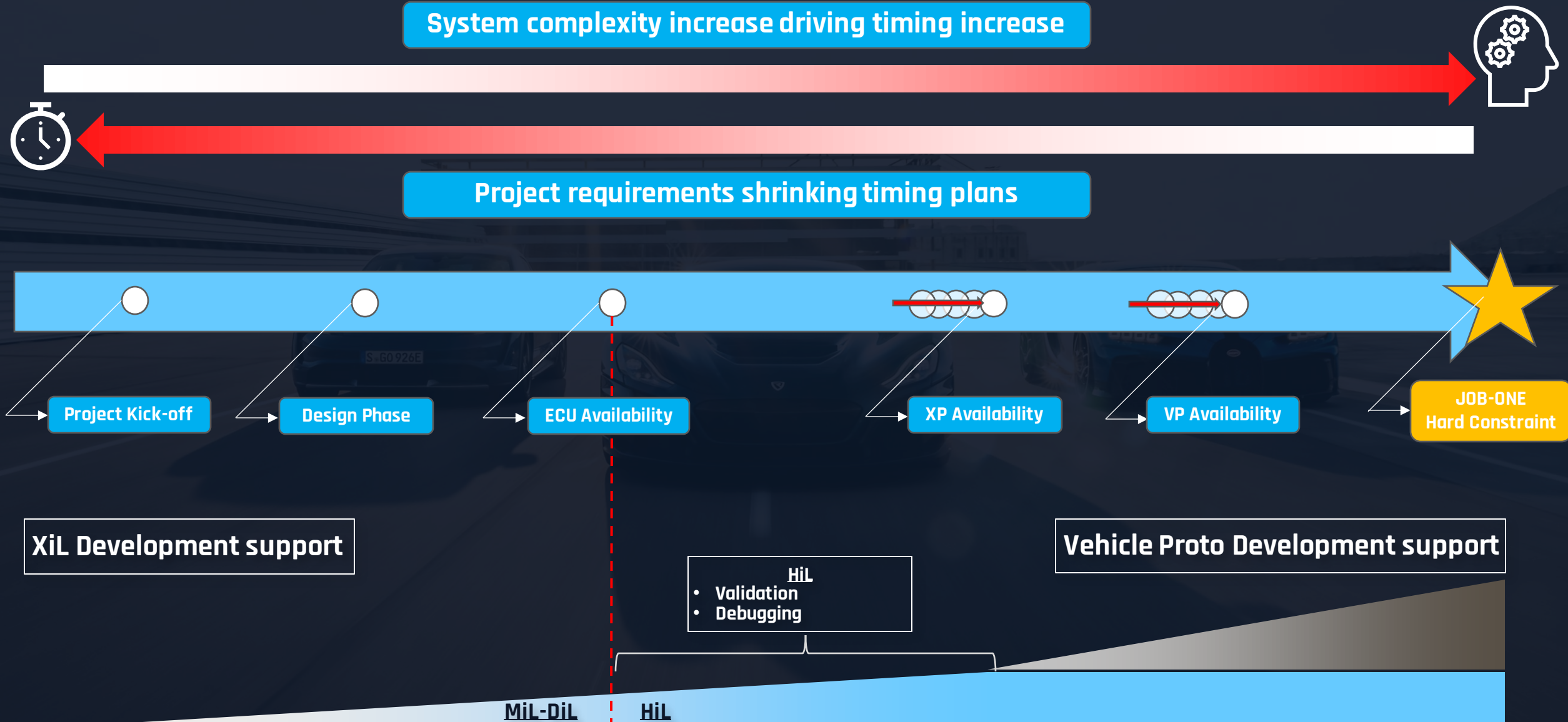
The proven techniques of an OEM-experienced engineering team with strong project leadership and technical expertise in design, simulations and controls applied to advanced powertrains and vehicle development



Thanks to our extensive experience in Vehicle Dynamics and Simulations combined with our expertise in Powertrain design, simulation and controls we bridge the gap between the two worlds



REASON WHY – PROBLEM



REASON WHY – SOLUTION



DiL

- Provides subjective feedback from drivers
- Is available as soon as a MiL is created
- **Lack of physical ECUs validation**



HiL

- Enables tuning and validation of ECUs SW
- Is usable as soon as the ECUs are available
- **Lack of driver subjective feedback**

DiL + HiL

- One step closer to real vehicle
- Network latency and real ECU HW effects are better captured



PROJECT PHASES

**PHASE-0****MiL/DiL**

- Development of a modular simulation model to support XiL Development

**PHASE-1****Longitudinal Drivability HiL (HiL+DiL)**

- Engine control unit(s), Transmission control Unit, Vehicle control unit

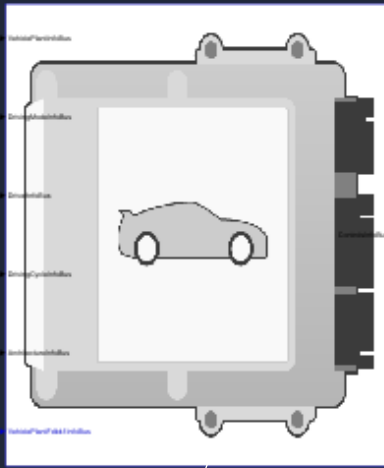
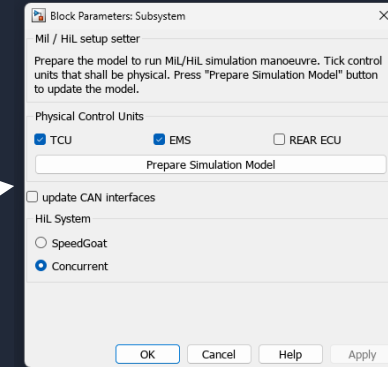
**PHASE-2****Combined Drivability HiL (HiL+DiL)**

- PHASE 1 + Brake by wire ECU, Electronic stability control unit, brake hydraulic plant

**PHASE-3****Coupling with Powertrain Rig (HiL+DiL)**

PHASE 0 – MiL-HiL-DiL Implementation

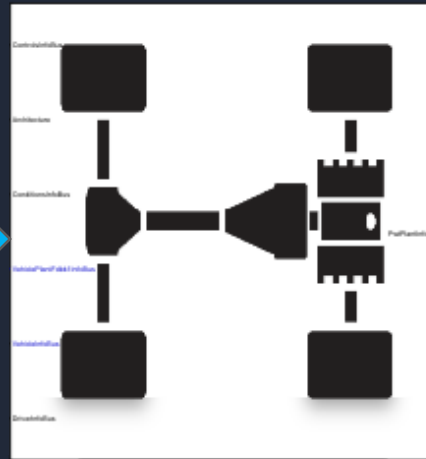
Automatic simulation mode setup
Toggling emulated-real ECUs and interfaces



- **Emulation of most of the vehicle ECUs**
- **Emulation of all the relevant CAN networks** through dynamically generated interfaces from DBC

- **Integrates and builds with IP-protected modules from different suppliers**

- **Numerically stable and RT capable**

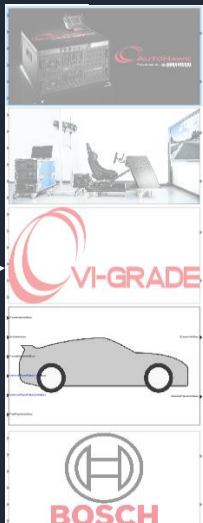


Plant Including:

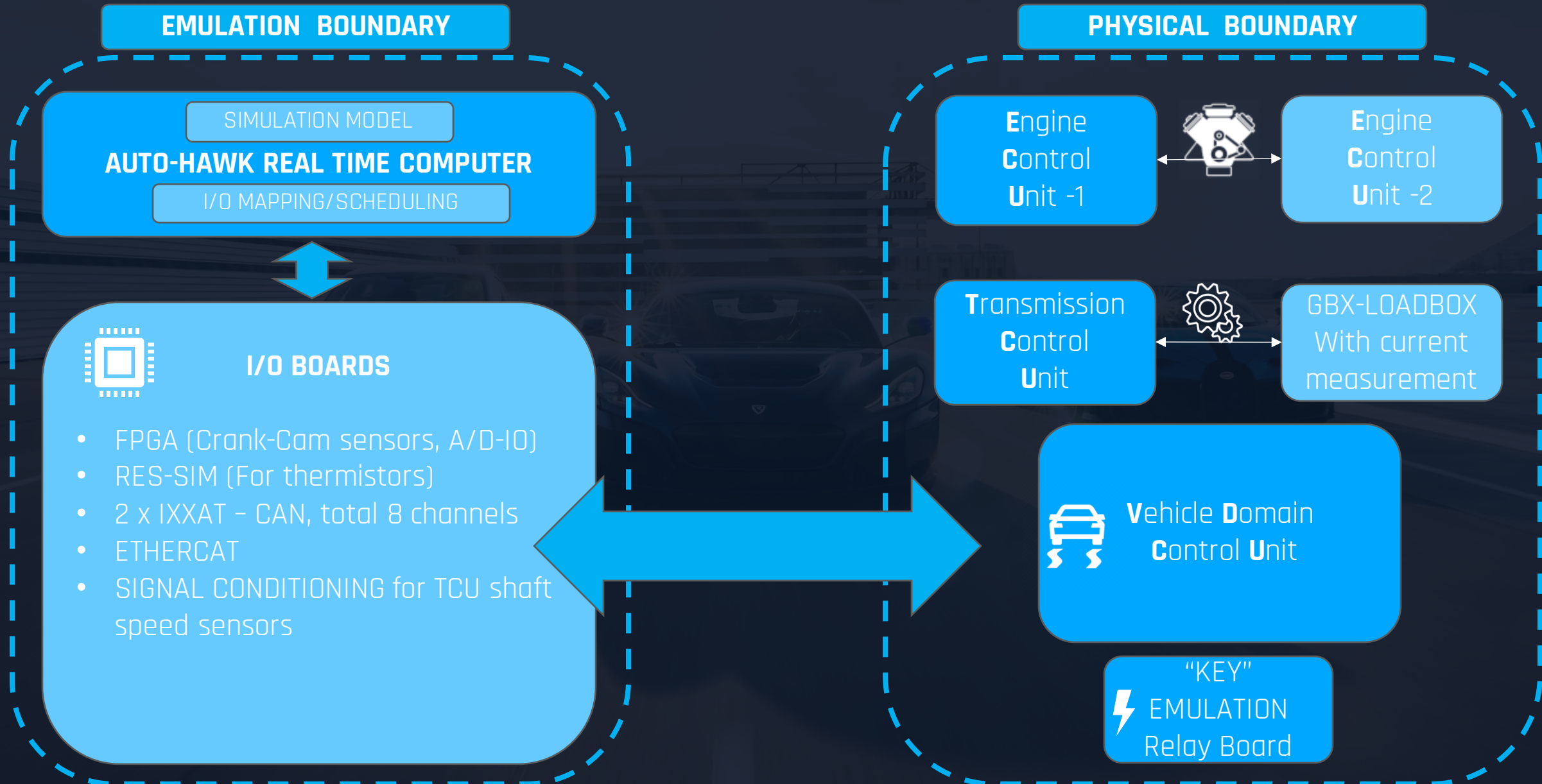
- ICE
- EMS
- Inverters
- GBX + eDiff
- Incremental VD model complexity
- Battery
- Main electrical loads
- [...]



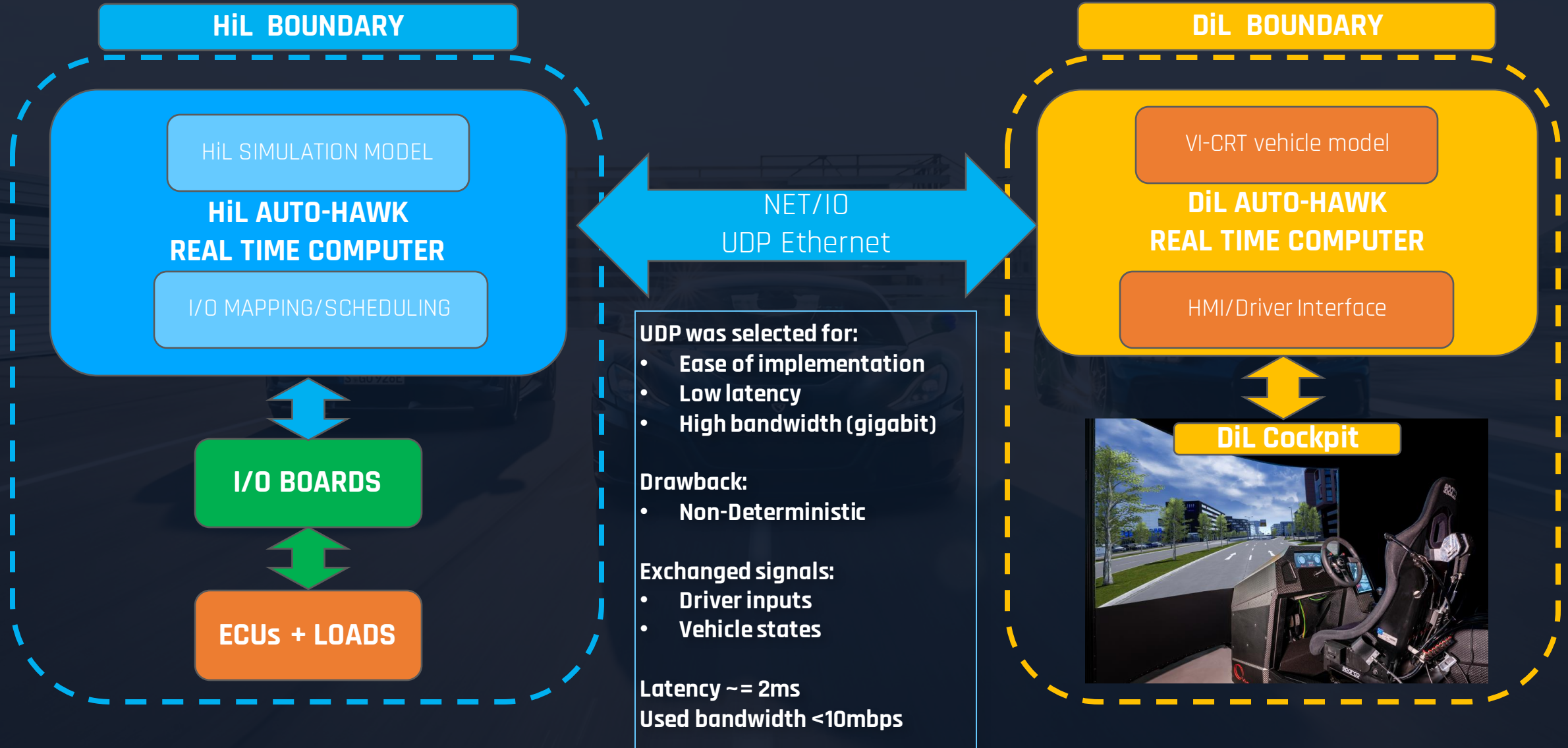
Incremental complexity VD models
licensed and un-licensed



PHASE 1 – Longitudinal drivability HiL (In use)



PHASE 1 – Connection to DiL (In Use)



Connection to DiL (In Use)

HiL BOUNDARY



Coupled system commissioned and in use for:

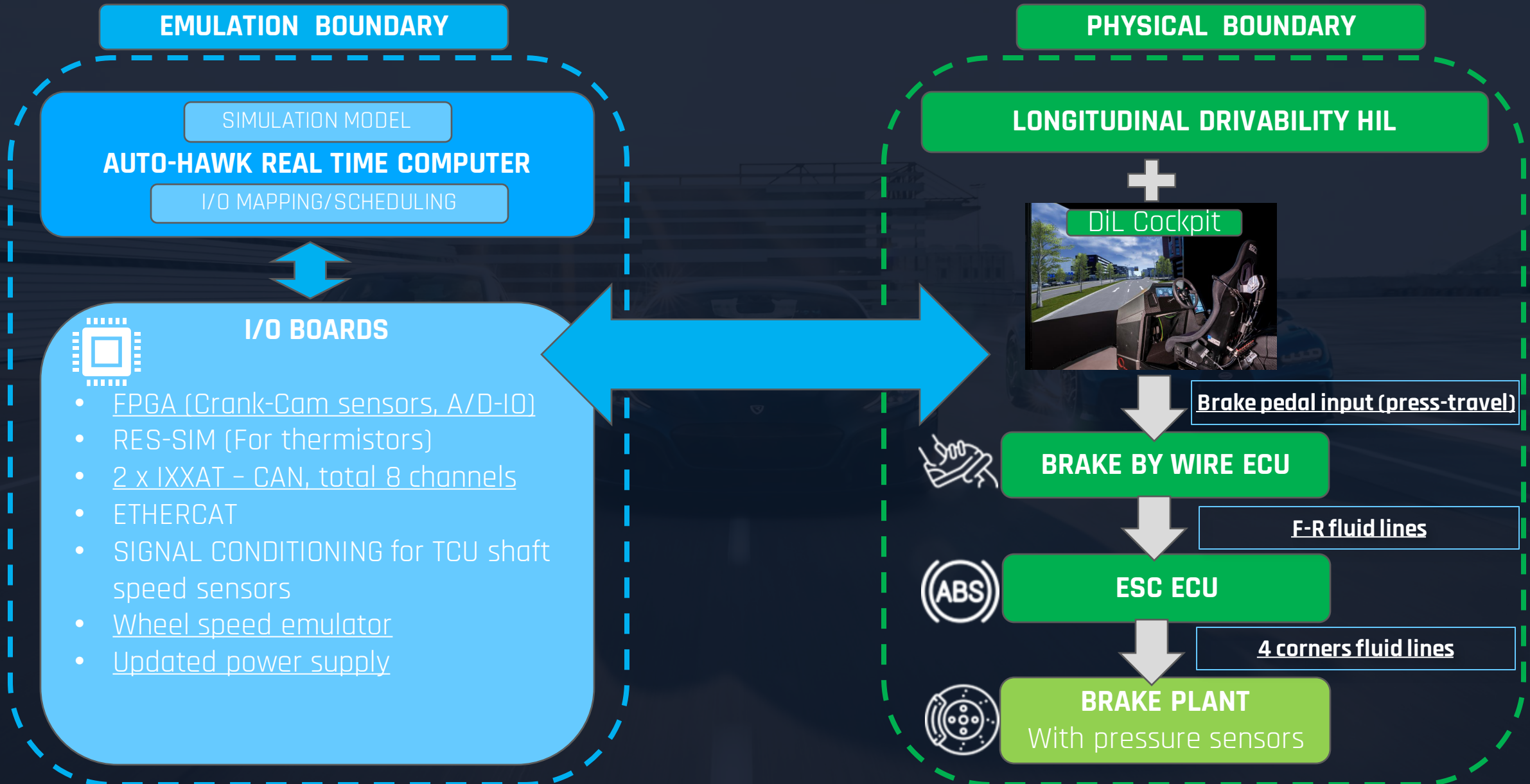
- Entire torque structure evaluation and debugging
- Drivability evaluation and tuning
- Quick ECU logs generation to pinpoint bug with suppliers



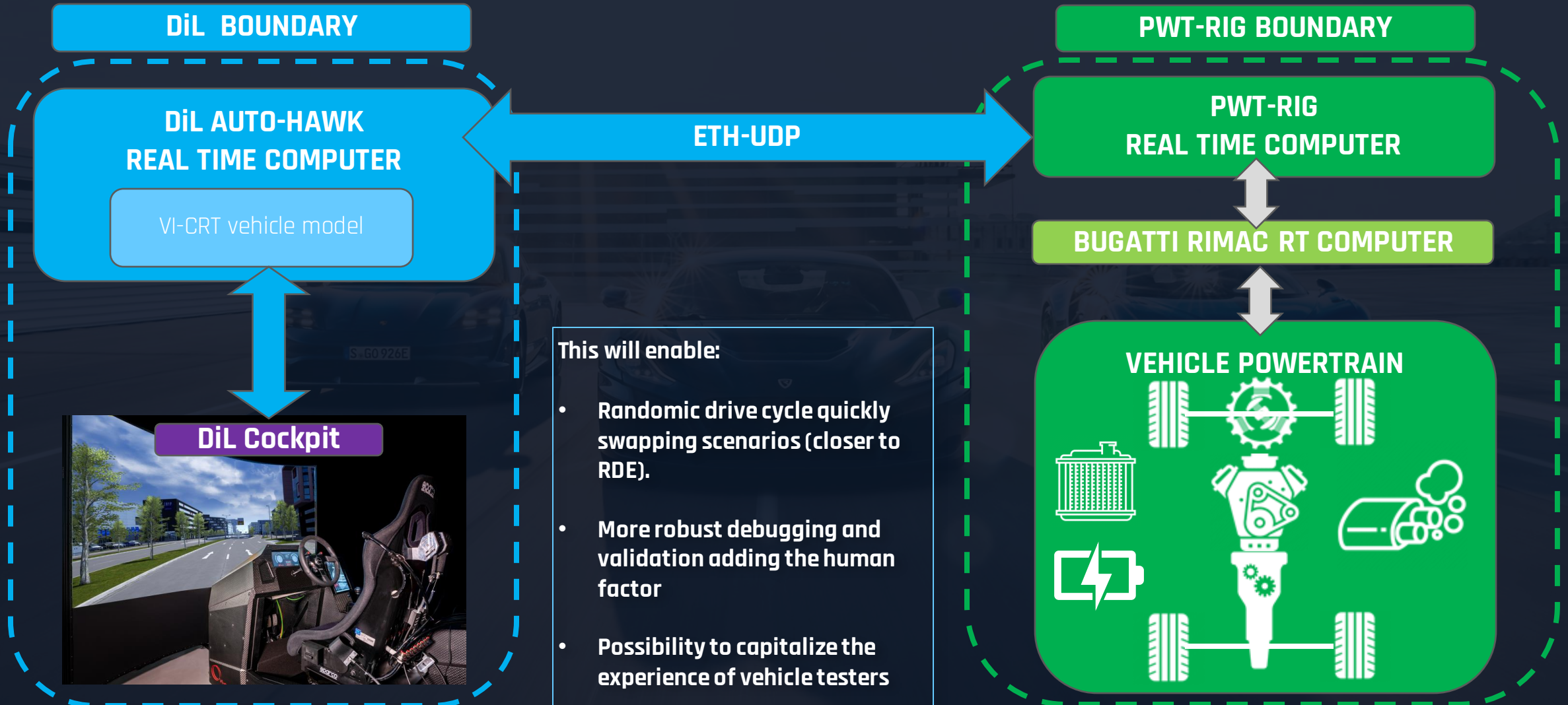
DiL BOUNDARY



PHASE 2 – Combined drivability HiL (Being implemented – integrated)



PHASE 3 – PWT RIG – DiL CONNECTION (Future development)



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THANK YOU FOR YOUR ATTENTION

LOOKING FORWARD FOR YOUR QUESTIONS

For any additional information you might need, feel free to contact us.



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