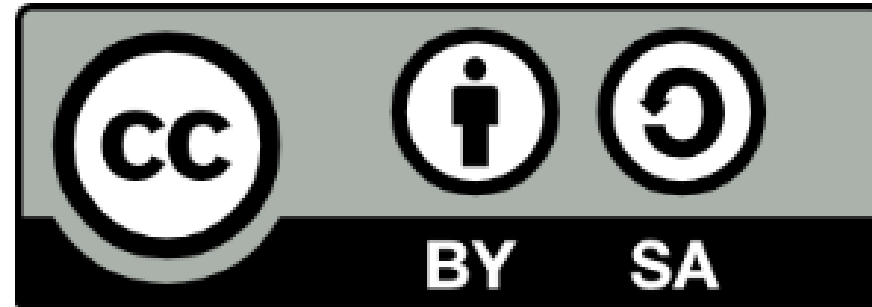




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eFMI® Tutorial – Agenda

Part 1: eFMI® motivation and overview (40 min)

Part 2: Running use-case introduction (10 min)

Part 3: Hands-on demonstration in Dymola and
Software Production Engineering (former name CATIA ESP) (25 min)

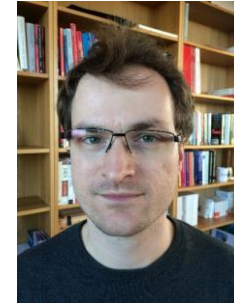
Coffee break (30 min)

Part 3: Hands-on demonstration in Dymola and
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Part 4: Live demonstration in TargetLink (30 min)

Part 5: Short presentation of further tooling (5 min)

Part 6: Conclusion (5 min)



Tutorial leader:
Christoff Bürger



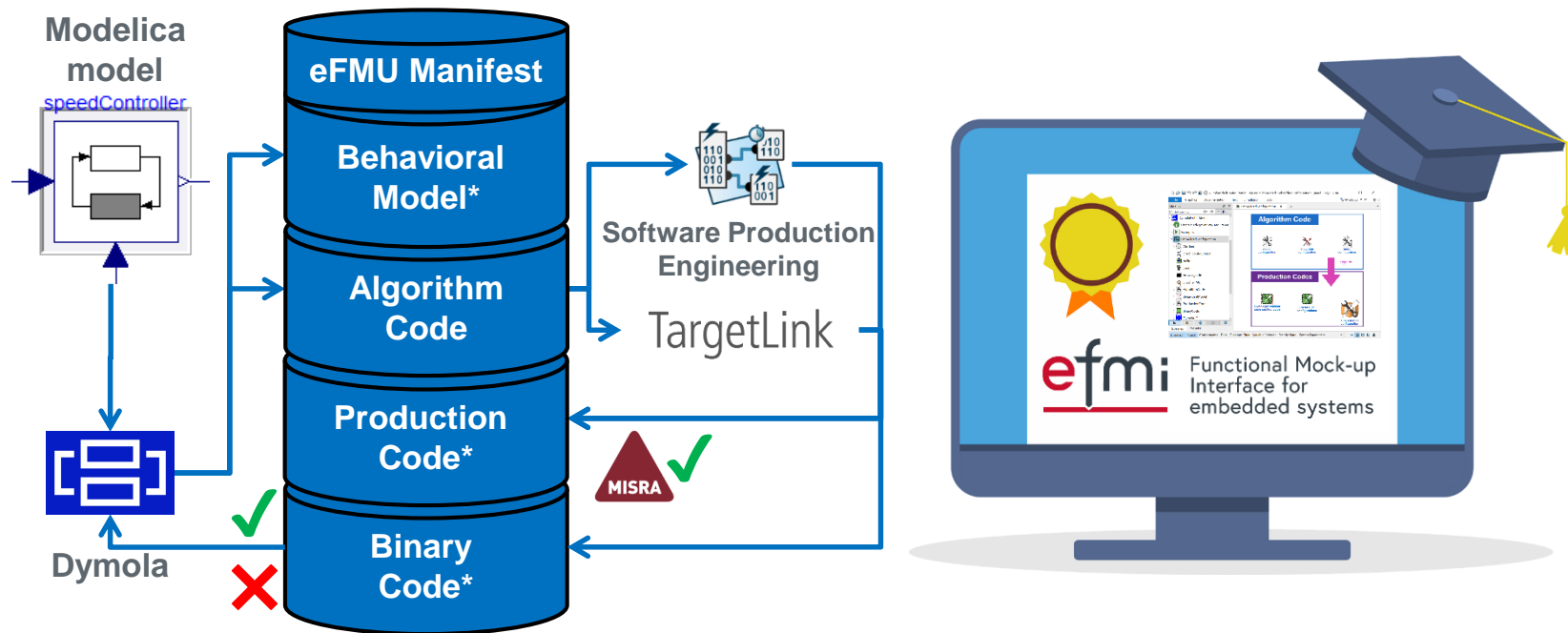
Presenter:
Oliver Lenord



Presenter:
Jörg Niere

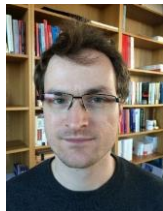


Functional Mock-up
Interface for
embedded systems



Part 5: Short presentation of further tooling

eFMI® Tutorial – 15th International Modelica Conference – 9th of October 2023

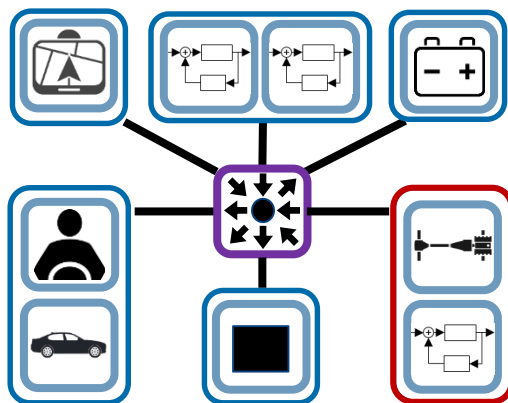
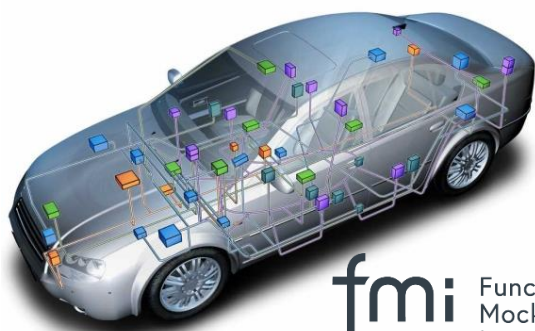


Christoff Bürger
Dassault Systèmes
Christoff.Buerger@3ds.com



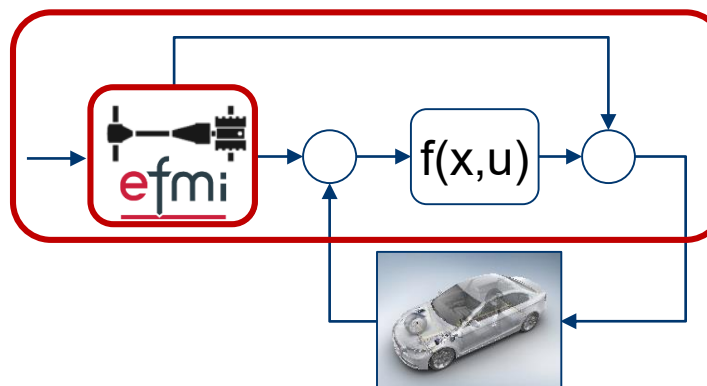
Focus of the following tooling: Embedded system integration

Model-based systems engineering

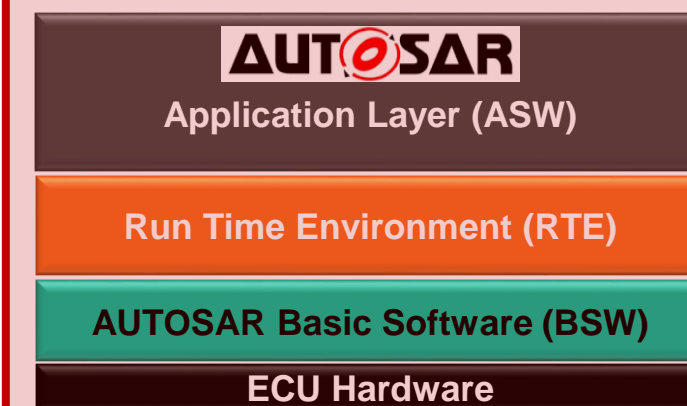


Model-based control

- Virtual sensors
- Feed-forward control
- Model-based diagnosis
- Model predictive control
- Advanced operating strategies
- ...

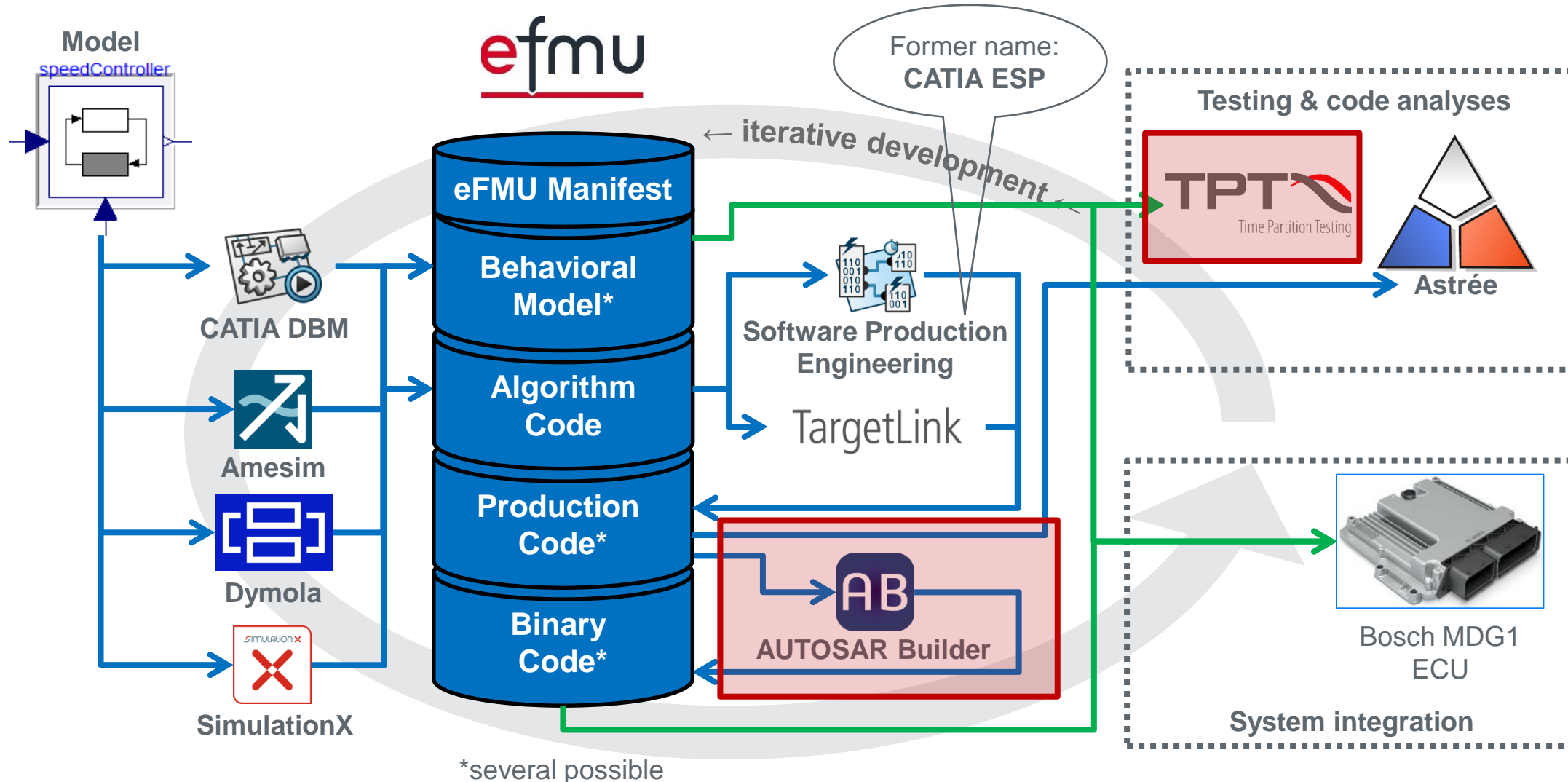


Software engineering





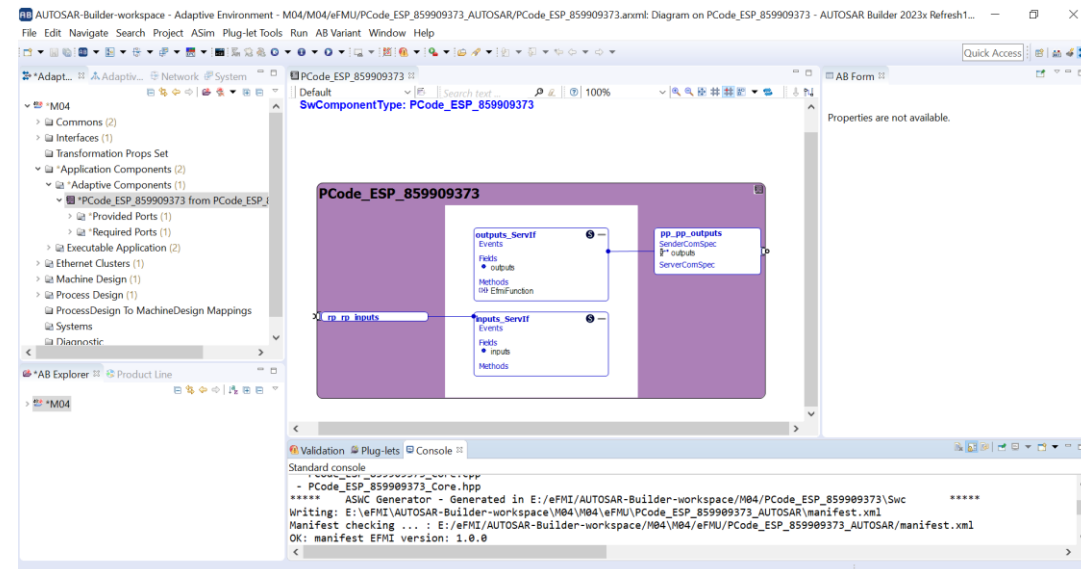
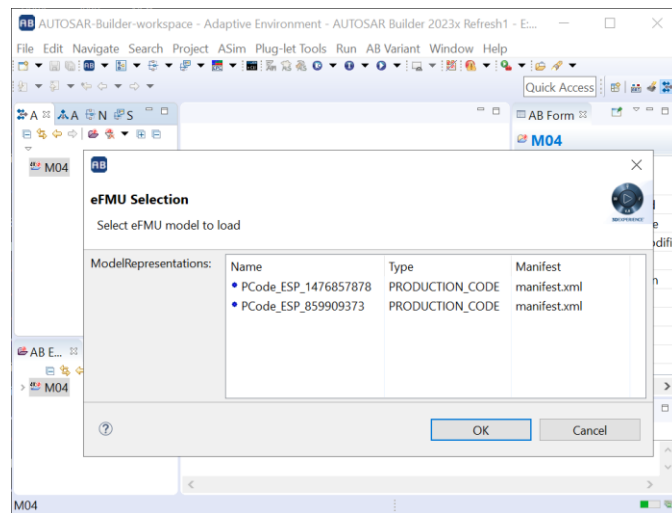
eFMI Standard: Toolchain & workflow





AUTOSAR Builder

- **General scope:** IDE for modeling, testing and validation of in-vehicle embedded systems for the AUTOSAR Classic and Adaptive Platforms, facilitating seamless integration with other AUTOSAR compliant tools based on the AUTOSAR Tool Platform (Artop).
- **eFMI Behavioral Model (BM):** Generate AUTOSAR test components for the test scenarios defined in BM containers.
- **eFMI Production Code (PC):** Adapt any eFMI PC container for the AUTOSAR Platform, yielding an AUTOSAR Platform compliant component ready for deployment in AUTOSAR-based target environments.
- **eFMI Binary Code:** Build binaries of AUTOSAR adapted PC containers for software-in-the-loop (SiL) tests.





TPT

- **General scope:** IDE for testing ECU software and embedded control systems in all development phases such as model-in-the-loop (MiL), software-in-the-loop (SiL) and hardware-in-the-loop (HiL) testing, supporting relevant safety standards, such as ISO 26262, and test assessment, reporting, management and requirements traceability.
- **eFMI Behavioral Model (BM):** Testing of BM containers in many well-known, automotive (embedded) execution environments.
- **eFMI Production Code (PC):** On the fly build of the C sources of PC containers for testing.

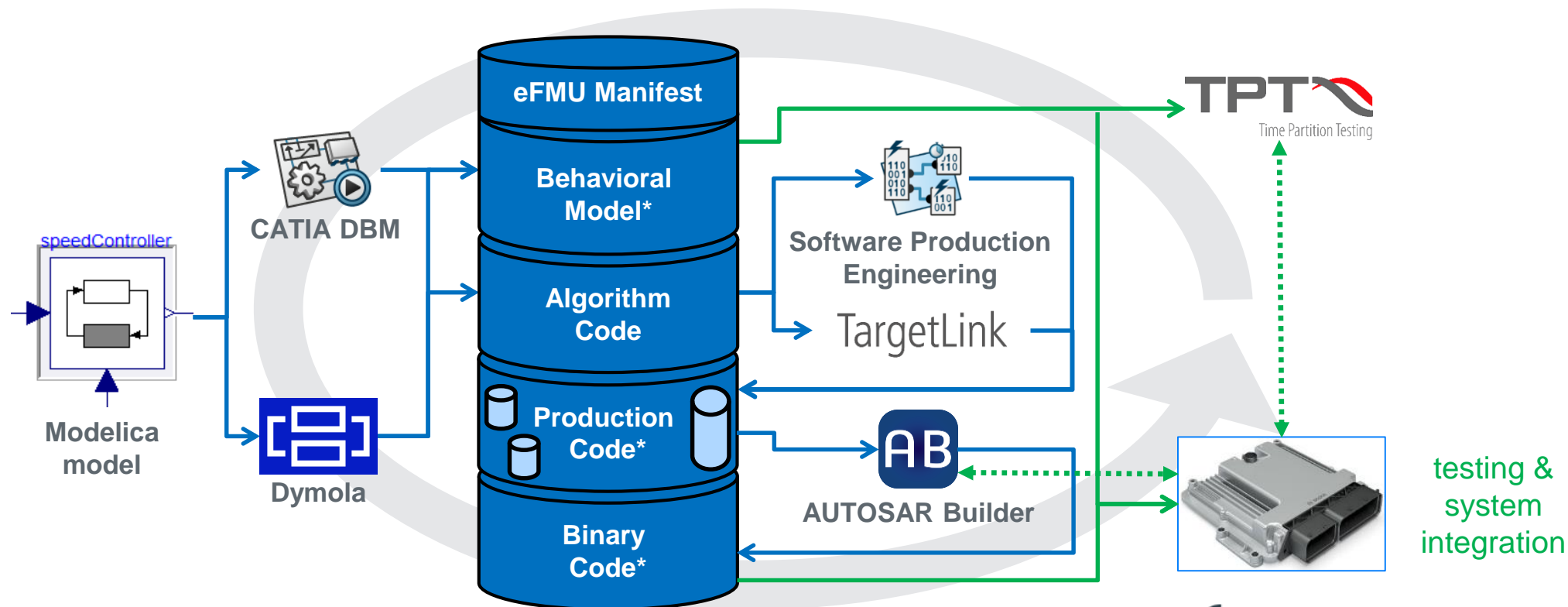
The screenshot displays the TPT IDE interface with several key components:

- Test Case Diagram:** A state transition diagram for a test case titled "Double Lane Change at 70 km/h". It shows phases: "phase 1" (lane change left), "phase 2" (lane change right), "phase 3" (lane change right), and "phase 4" (stay in lane and stop). Transitions are labeled with conditions like "speed >= 70 km/h" and "vehicle stopped".
- Graph:** A plot showing lateral displacement (lateral_dist) and lateral displacement rate (lateral_dist_deriv) over time. The x-axis represents time from 0 to 50, and the y-axis represents displacement from -75 to 75. The graph shows a series of oscillations corresponding to lane changes.
- Requirements Table:** A table listing requirements (SPEC-15 to SPEC-18) with their attributes and values.

ID	Text	Value
SPEC-15	If light_switch starts operating in mode AUTO or changes to mode AUTO during operation and light_intensity is greater than MIN_LIGHT_OFF, then headlight shall immediately be OFF.	1
SPEC-16	If light_switch starts operating in mode AUTO or changes to mode AUTO and light_intensity is less than 3	2
SPEC-17	During light_switch operates in mode AUTO and light_intensity is less than 3	2
SPEC-18	During light_switch operates in mode AUTO and light_intensity is greater than 4	2



Soon™: eFMUs in MATLAB & Simulink

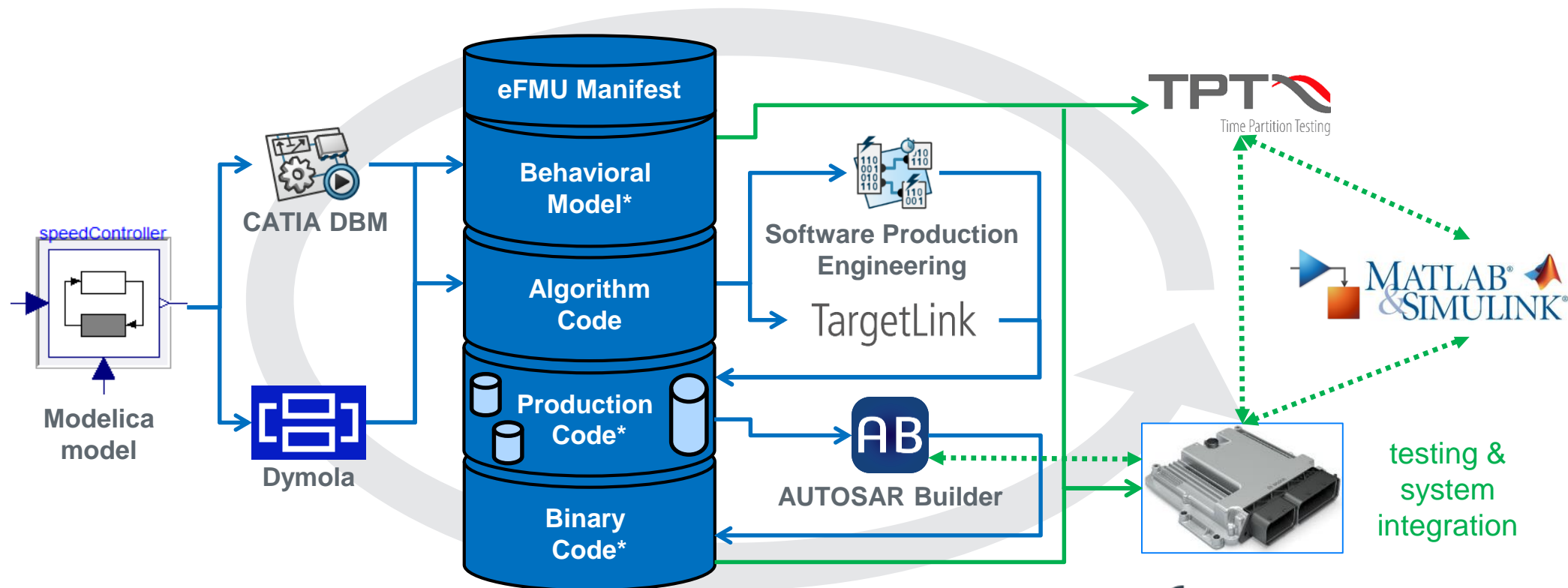


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Soon™: eFMUs in MATLAB & Simulink

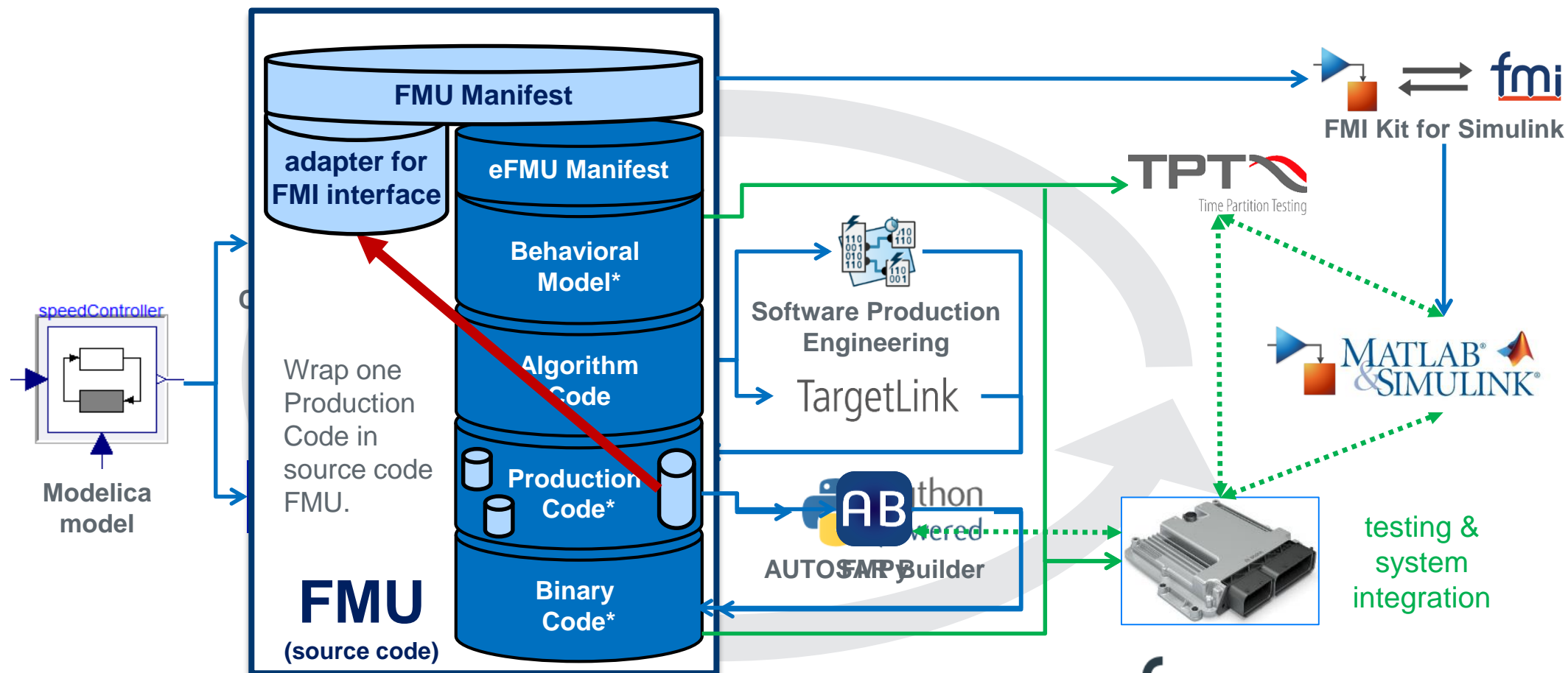


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Soon™: eFMI support in FMPy & FMI Kit for Simulink

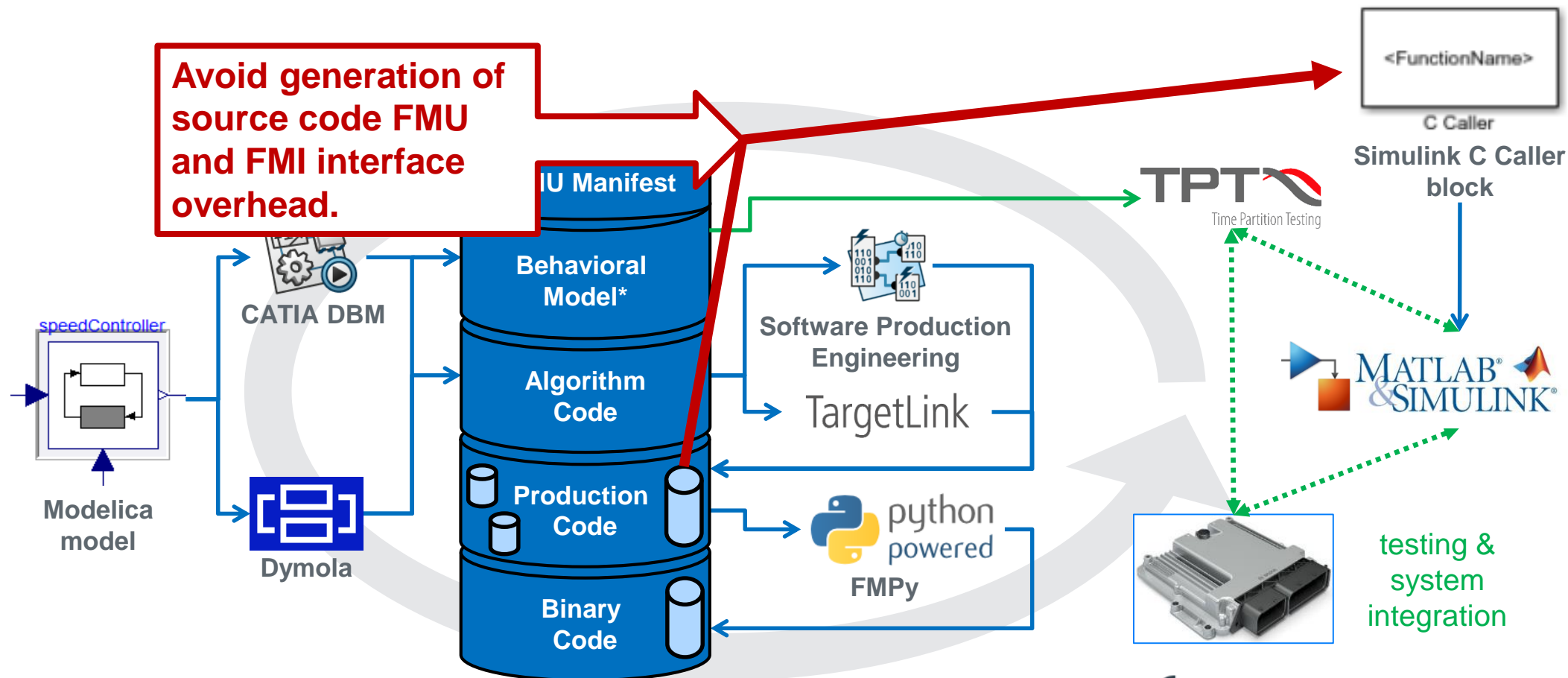


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Soon™: FMPy generating Simulink C Caller block



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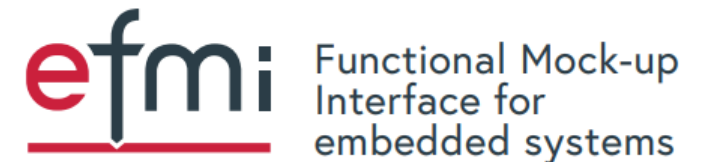




Questions from the audience

Which system integration scenarios outside the MATLAB – Simulink world exist for eFMI?

Which embedded target domains, platforms and ecosystems do you support?





Questions from the audience

What are the short and long term objectives of eFMI?

What is the focal point for the success of eFMI?

What are your future research & extension perspectives?





Questions from the audience

eFMI is a very broad subject.

Isn't there a risk that only super experts can handle it all?





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Functional Mock-up
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