Software-Defined Everything

Inspiring Innovation in IoT with AI and Model-Based Engineering

Luis Garduño
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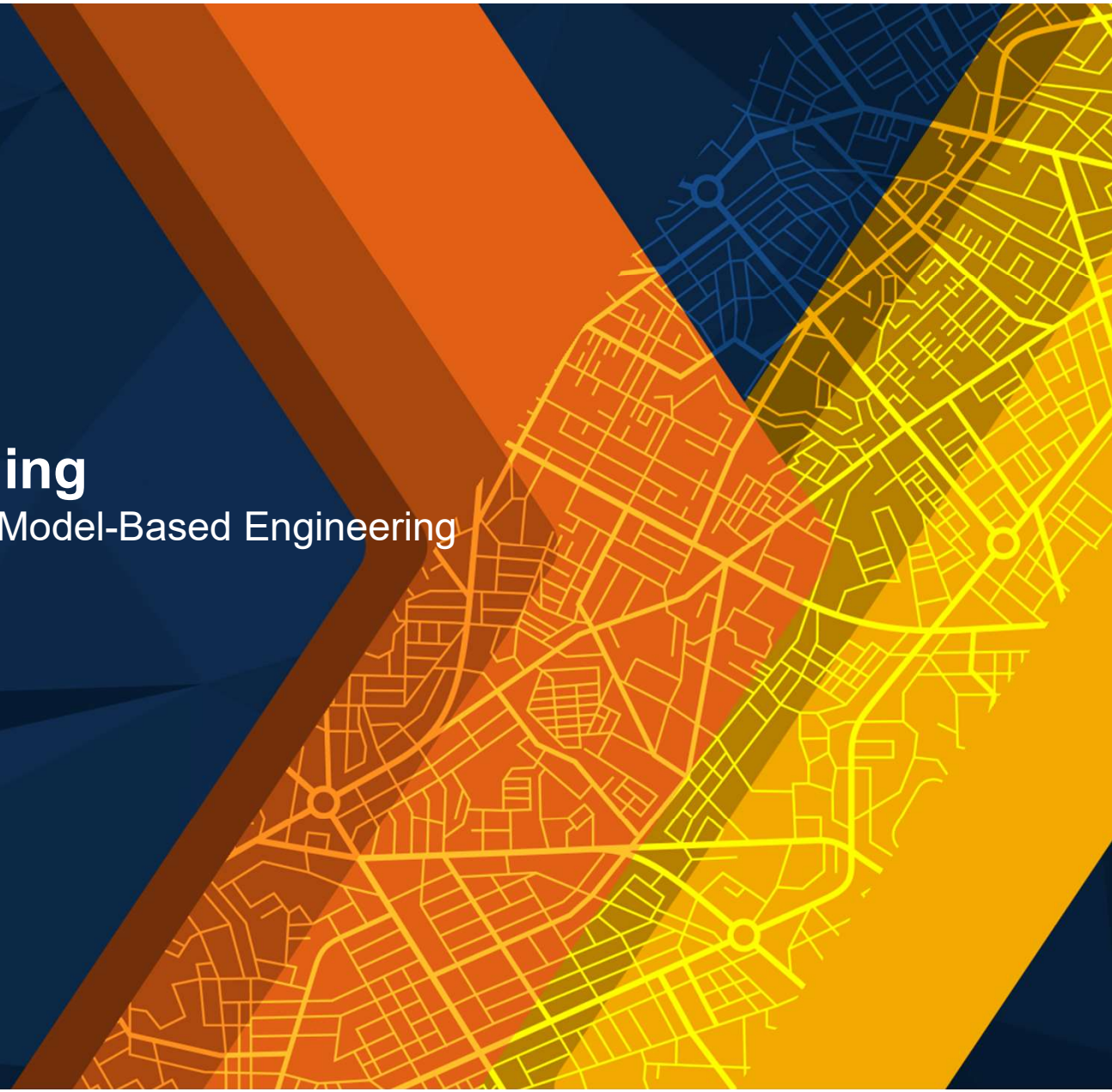

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Abstract

- This presentation explores how software-defined everything transforms the **Internet of Things across Bosch's diverse product portfolio**, following the rhythm of a typical day. From smart mobility and sustainable energy to connected living and industrial automation, Bosch technologies interact seamlessly to create meaningful experiences. Central to this vision are Model-Based Design and Model-Based Systems Engineering, empowered by AI to infuse intelligence into every system. With MathWorks tools at the core, teams accelerate innovation by simulating, designing, and integrating software-driven solutions across domains. The result is a future where engineering excellence and software-defined intelligence naturally shape everyday life.

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Who Let This Guy on Stage?

10.000 Users, one TAM… sounds scalable, right?

About me

- Born and raised in Mexico City
- Living for 17+ years in Germany
- Located in Stuttgart
- Mechanical Engineer
- Specialized in Aerodynamics
- 5+ years at Volkswagen
- Turned into “System Architect” for large organizations

Current role

- Joined MathWorks 6 years ago
- Global Technical Account Manager (TAM) for Bosch
- Supporting over 10.000+ users worldwide
- Account spans mobility, industry, consumer divisions

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Software-Defined Everything

Brand-distinctive features and main customer value comes from software

Customer expectations

- Safe technology
- Sustainable
- Digital life continuity

Source: Google AI Studio

Technology and innovation

- Smart tech
- Autonomous
- Connected

Business opportunity

- App stores, software features on demand
- Subscription plans for software services

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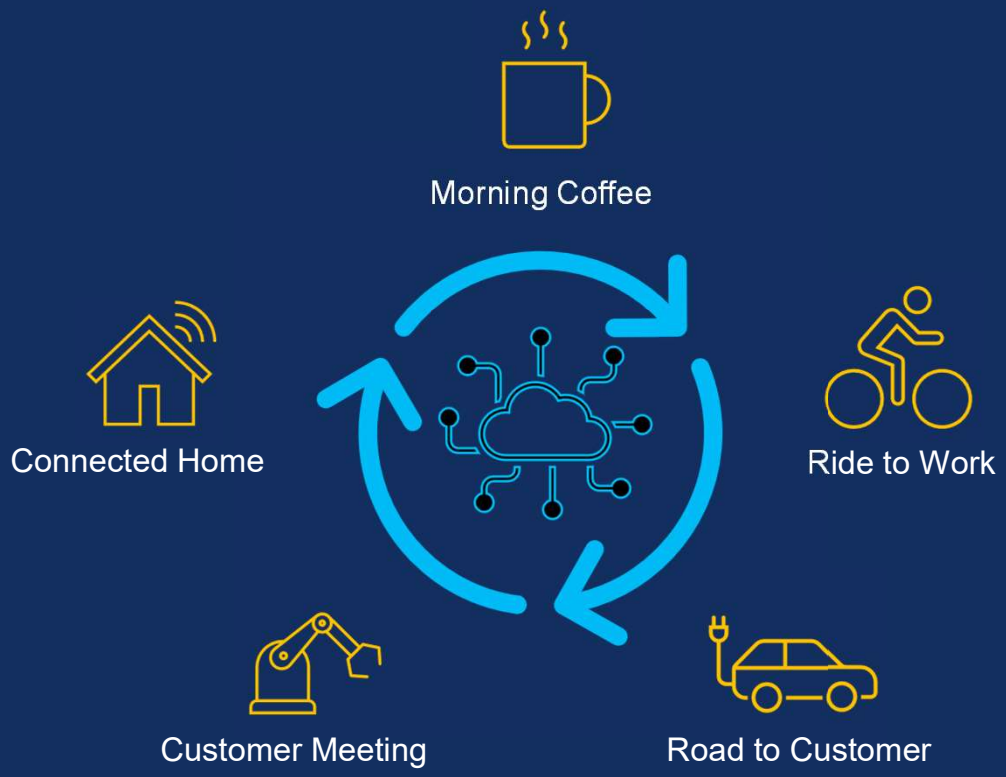
Software-Defined *Day*

The Coffee to Bed Cycle



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Software-Defined *Coffee*

Even my caffeine has a simulation model

What do we do?

- Virtually test and validate models
- Satisfy demanding customers on quality and safety requirements

VeroCafe Diamond Serie 2
Source: BSH GmbH

Source: Google AI Studio

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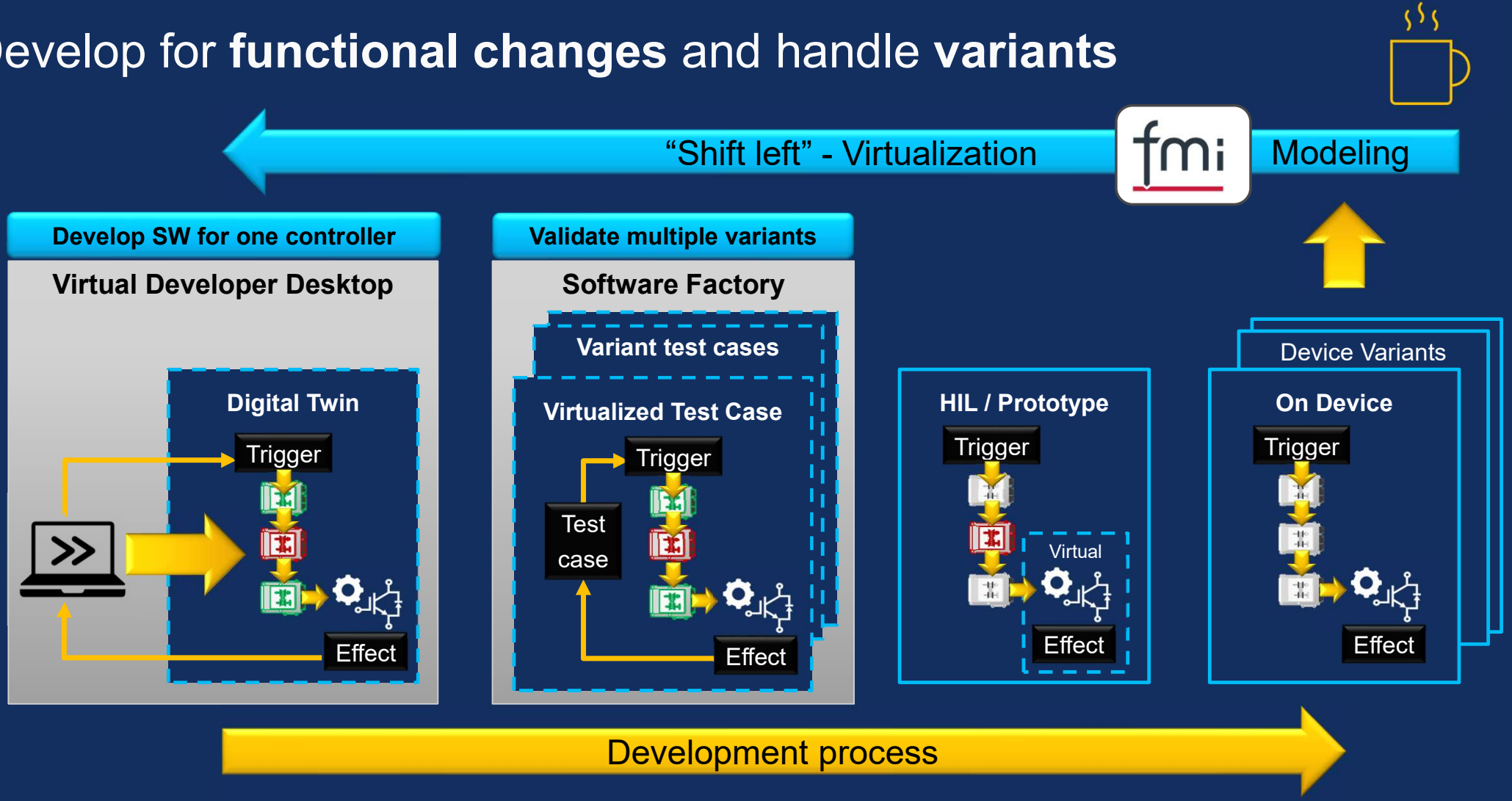
Develop for **functional changes** and handle **variants**



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Two Wheels First: Bosch eBike

OTA updates: Because pedals alone aren’t enough anymore

What do we do?

- For over 10 years we have supported eBike development
- It is not mechanical systems alone – controllers designed with MBD
- These systems need to be centralized

Electric Bike Controller
User Story

Source: Google AI Studio

Source: Bosch E-Bike

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Software Defined *Vehicle*

Mobility buzzwords change faster than CAN signals on a busy bus

What do we do?

- Automotive trends: Autonomous, Electric, Connected, Shared
- Complexity outpaces traditional development methods
- 20+ years supporting Mobility development at Bosch

Source: Google AI Studio

Cross Domain Simulation User Story
ECU Architecture User Story

Source: Google AI Studio

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Software-Defined Vehicles

Modern Software Practices

Reliability

Data-Driven Functionality

Functional Safety

Leverages Cloud

Physical Components

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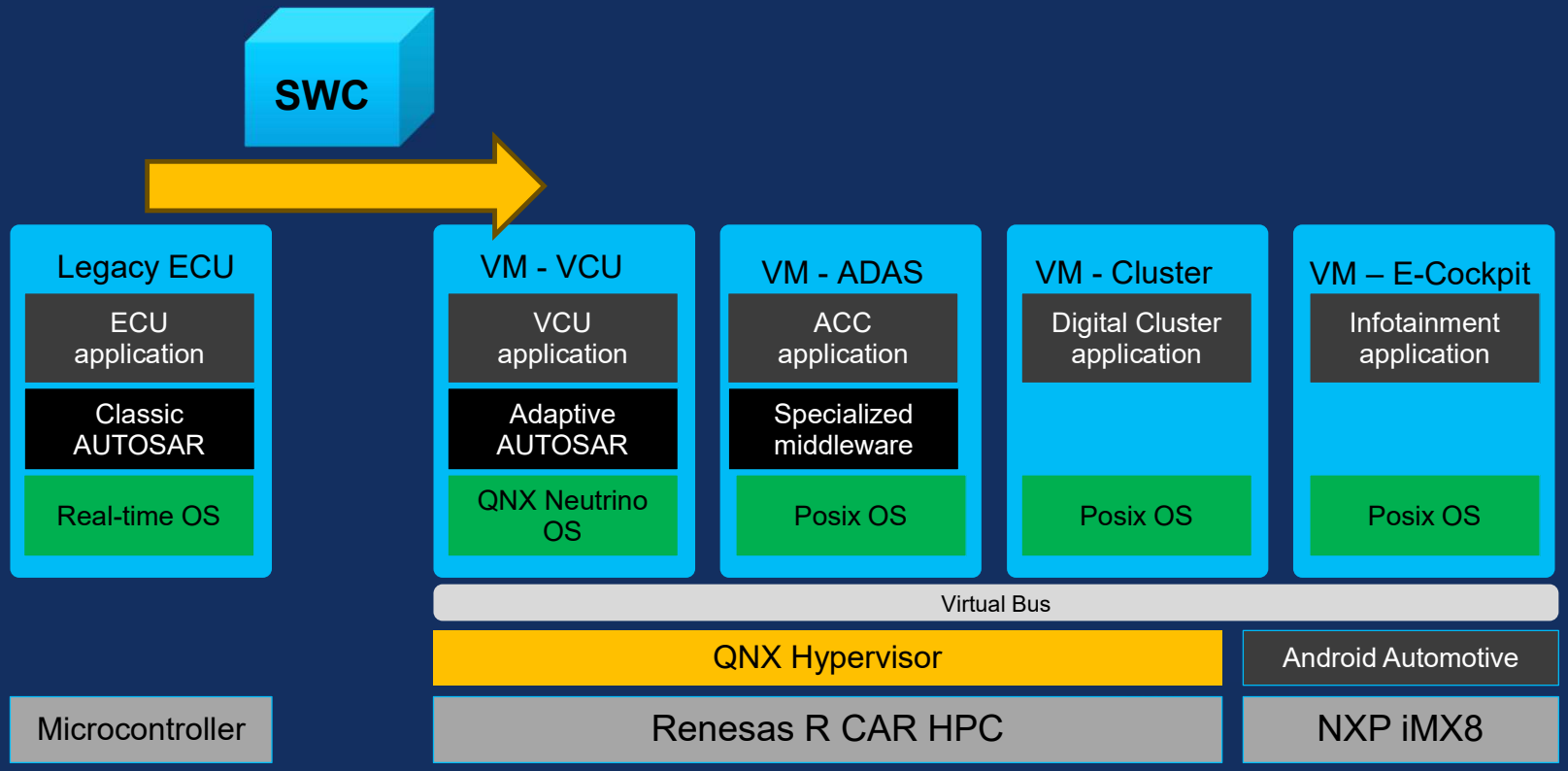
Re-target to **middleware** – maximize reuse

- PoC application SWC transition legacy ECU to VCU



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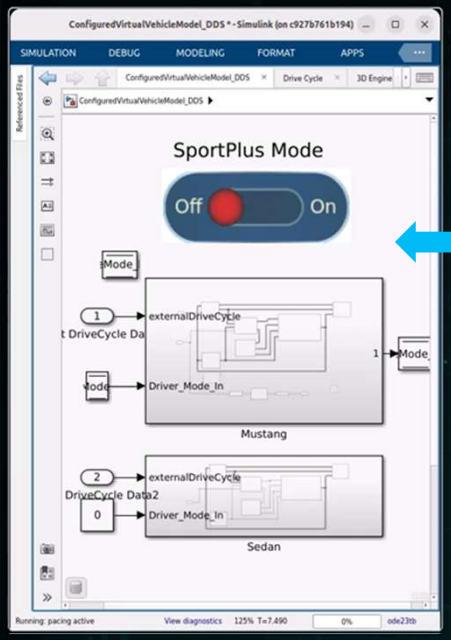
Automotive Software Development in the Cloud

powered by aws

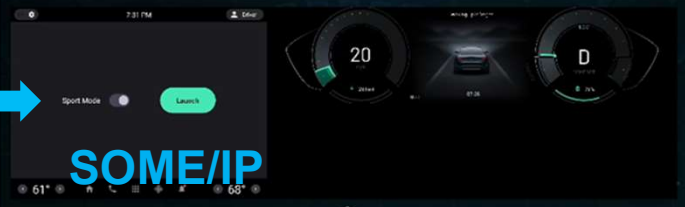


Application Code from Model

Elektrobit

Road-ready Automotive Software

Infotainment (Android Automotive OS)



SOME/IP

SYNOPSYS®

Virtual ECUs in Synopsys Silver

ECU Simulation

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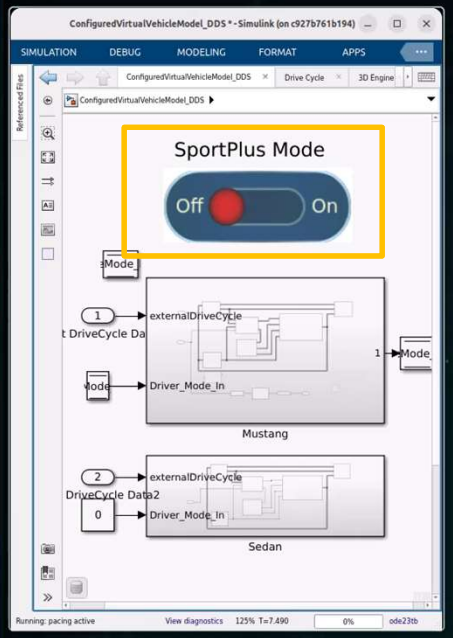
powered by aws



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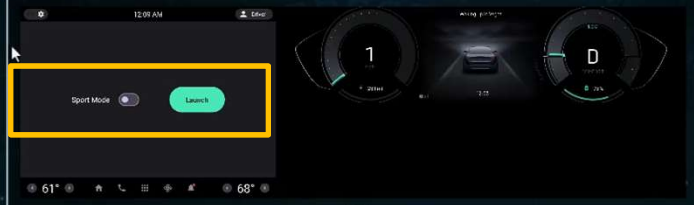

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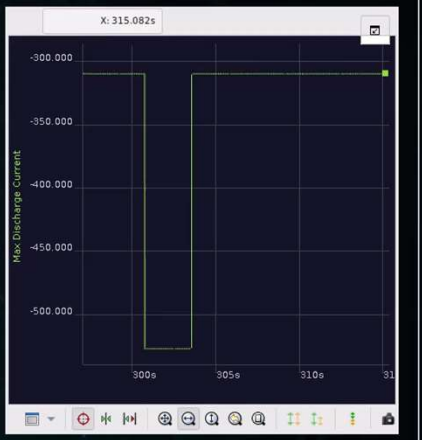
Virtual ECUs in Synopsys Silver



ECU Simulation

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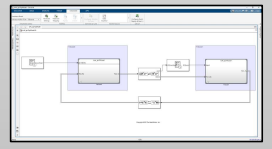
Automate (major parts of) HW optimization

Auto-generate optimized, performant, compliant code

SoC Blockset Support Package
Infineon AURIX™ TC4x



Optimize on model level

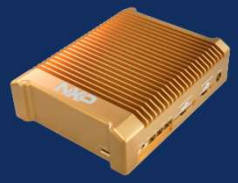
- Partition algorithms to run on multiple TriCore cores and on PPU
- Analyze algorithm resource usage and task execution

Deploy to HW

- Generate optimized code for SIMD PPU Core and multiple TriCore cores
- Performing Processor-In-Loop tests on PPU and TriCores

NVIDIA
Jetson GPU

FPGAs



NXP® GoldBox
for in-vehicle HPC

Qualcomm®
Hexagon™ NPU for Snapdragon

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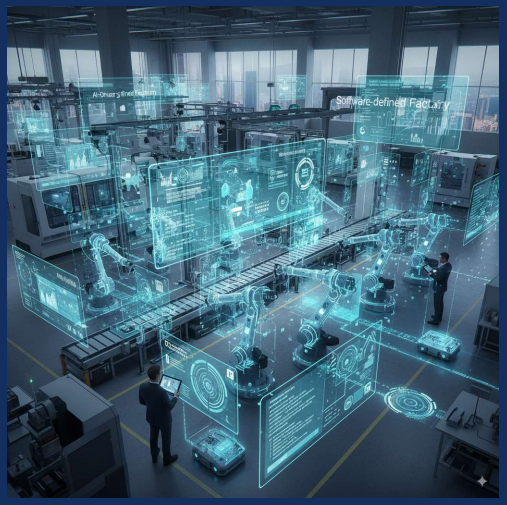
Software Defined *Factories*

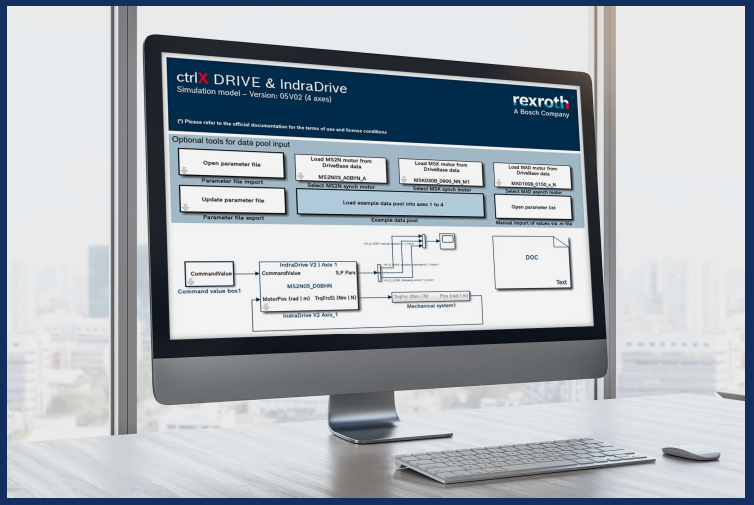
Software alone won't build does cars

What we do:

- ctrlX CORE: open, Linux-based industrial controller.
- Enable Cloud-Based algorithm deployment into control layer



Source: Google AI Studio



Reality

Source: Bosch Rexroth GmbH

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Hans Michael Krause
Head of Product Management
ctrlX World at Bosch Rexroth

Source: Press Release

"Thanks to the direct link between the simulation and automation platforms, users save a lot of time, because they can **virtually test the machine or system in the model** prior to its completion. So the digital twin of the machine comes first, before it's set up by the machine manufacturer. Errors can thus be **recognized and eliminated ahead of time**, processes optimized and much more."

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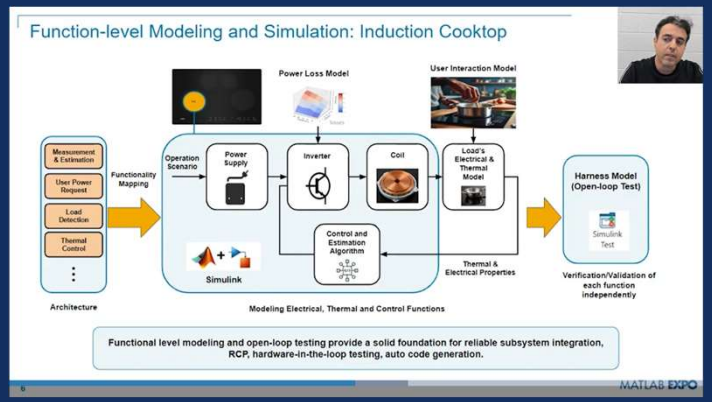
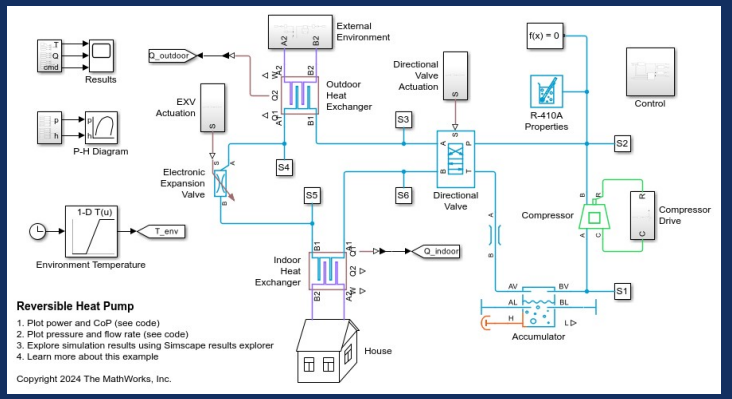
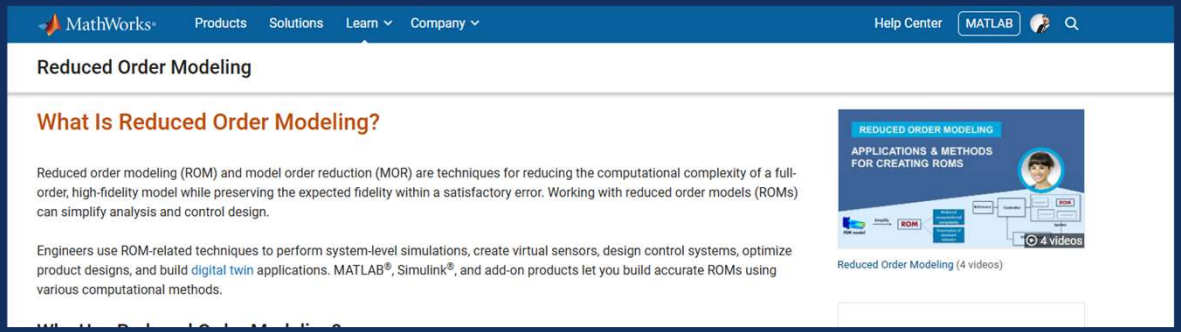
Function-level Modeling
For a fully connected living



Whirlpool User Story



Reversible Heat Pump Shipping Example



Reduced Order Modeling - MATLAB & Simulink

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Software-Defined *Everything*

Takeaways

- Software defines hardware
- Models accelerate innovation
- AI makes systems smarter (not only LLMs)
- Workflows connect domains
- Challenge and an opportunity to work closer

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Thank you!

Luis Garduño
lgarduno@mathworks.com

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