PAVE360: From Chip-to-Vehicle Verification Continuity

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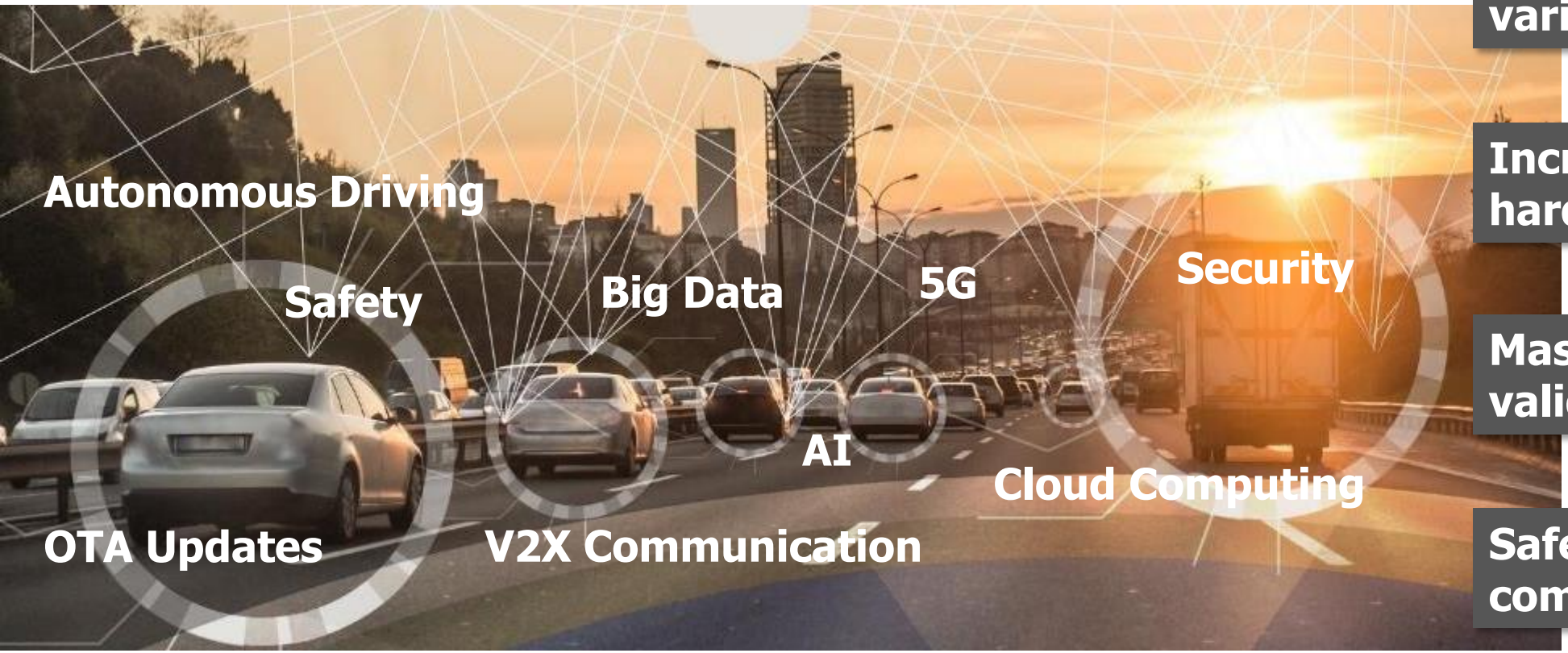
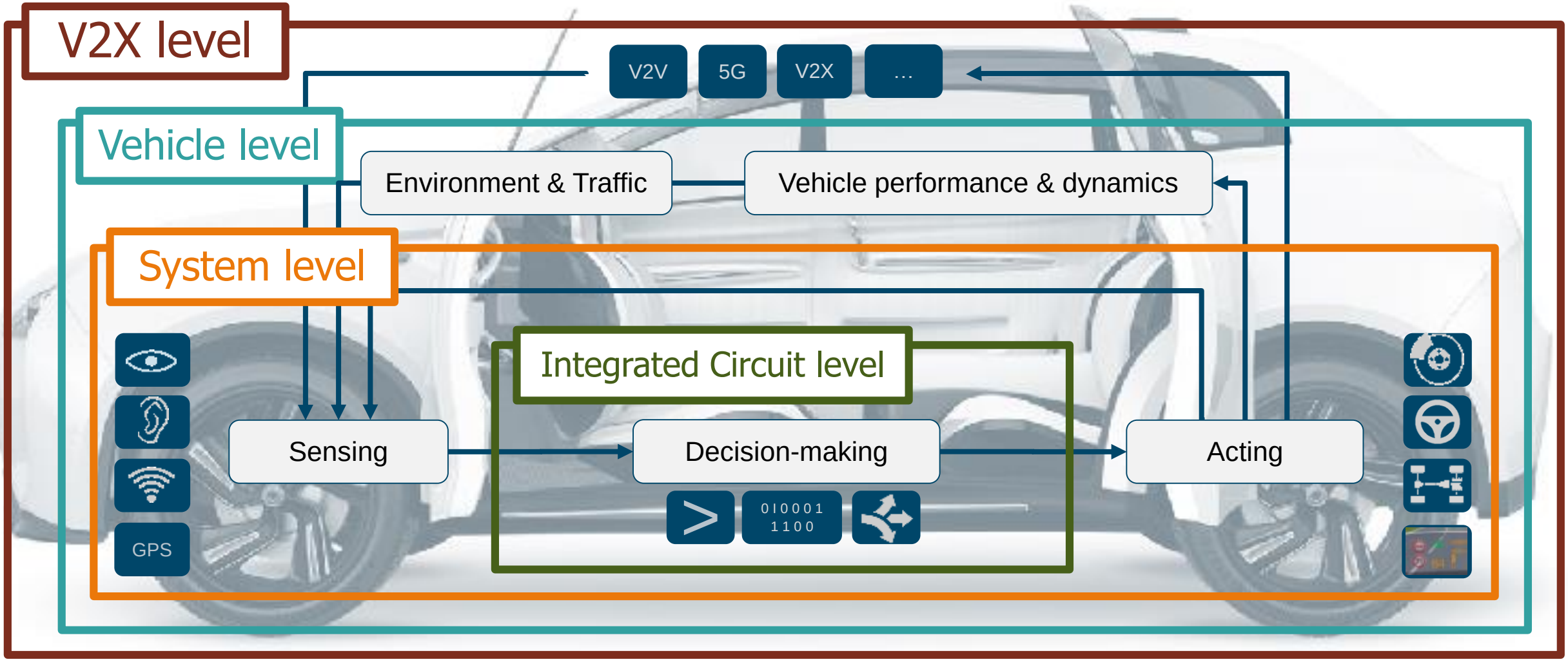
Autonomous Driving: Technology Convergence Creates New Challenges

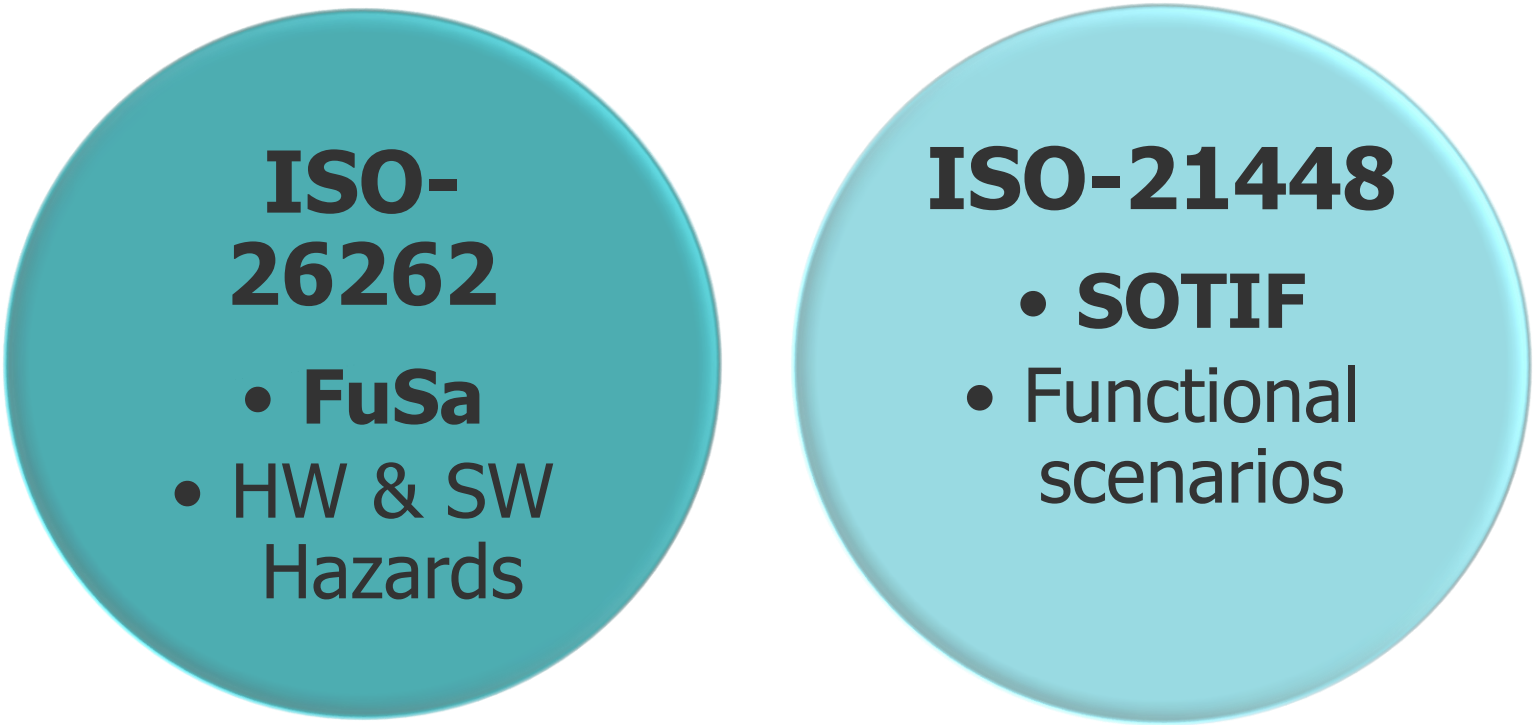


- Growing number and variety of sensors
- Increasing software and hardware complexity
- Massive verification and validation cycles
- Safety, security compliance

Electronic system of system challenges for AV verification and validation



Safety Standards Verification



Self-driving technology requires massive verification cycles to reach safety for "Level 5"

"14.2 billion miles of testing is needed"

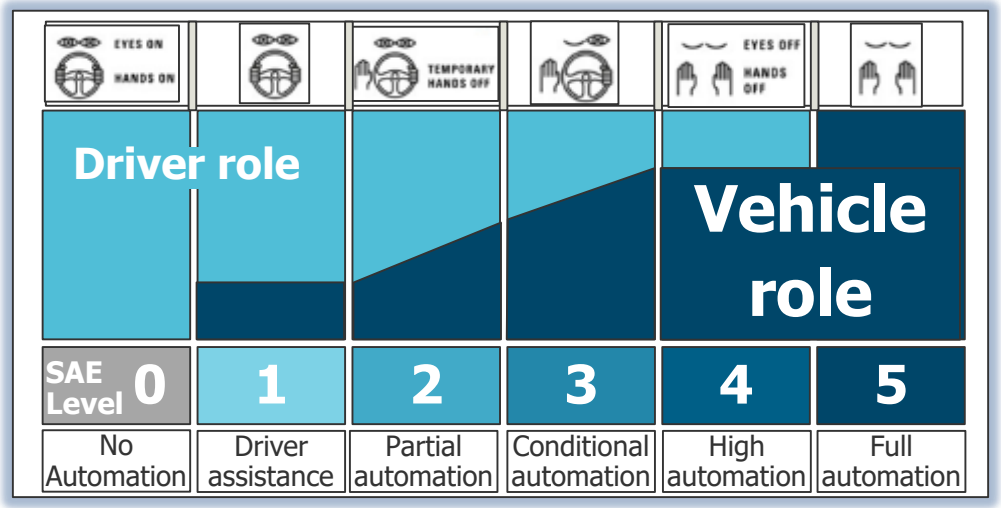
Akio Toyoda, CEO of Toyota
Paris Auto Show 2016

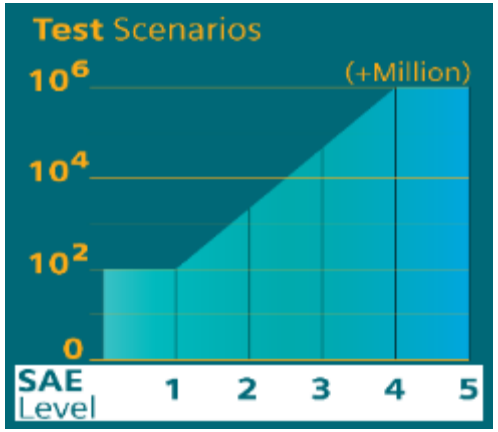
"Design validation will be a major – if not the largest – cost component"

Roland Berger
"Autonomous Driving" 2014

"While hardware innovations will deliver - software will remain a critical bottleneck"

McKinsey
"When will the robots hit the road?





A Virtual System Validation Environment to Shift Left The Development Cycle

Sense

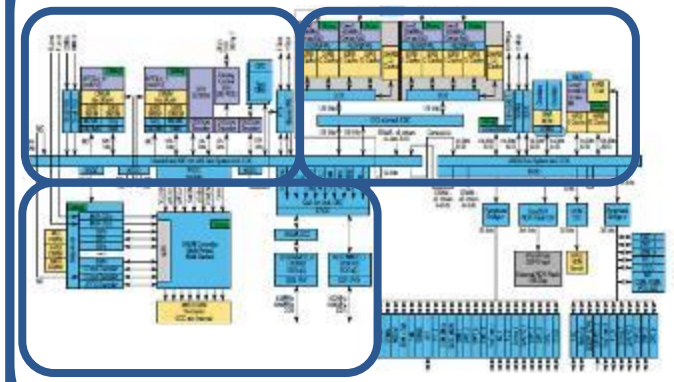
Siemens

Tass' PreScan

Decide

Siemens Mentor

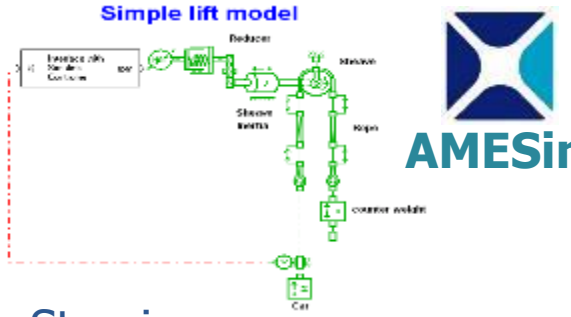
Hardware Verification Platform



Actuate

Siemens

AMESim

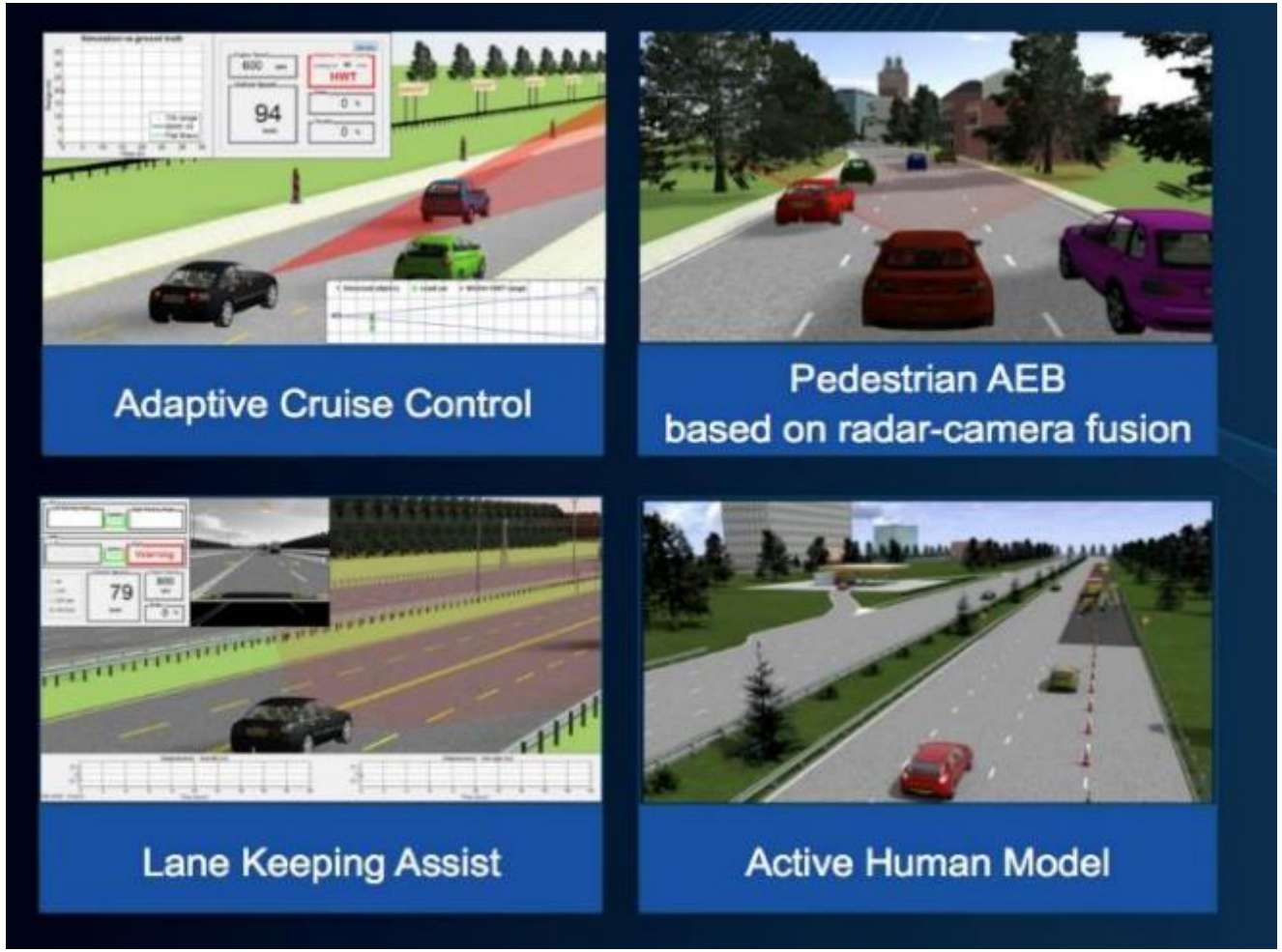


Steering

Braking

Drivetrain

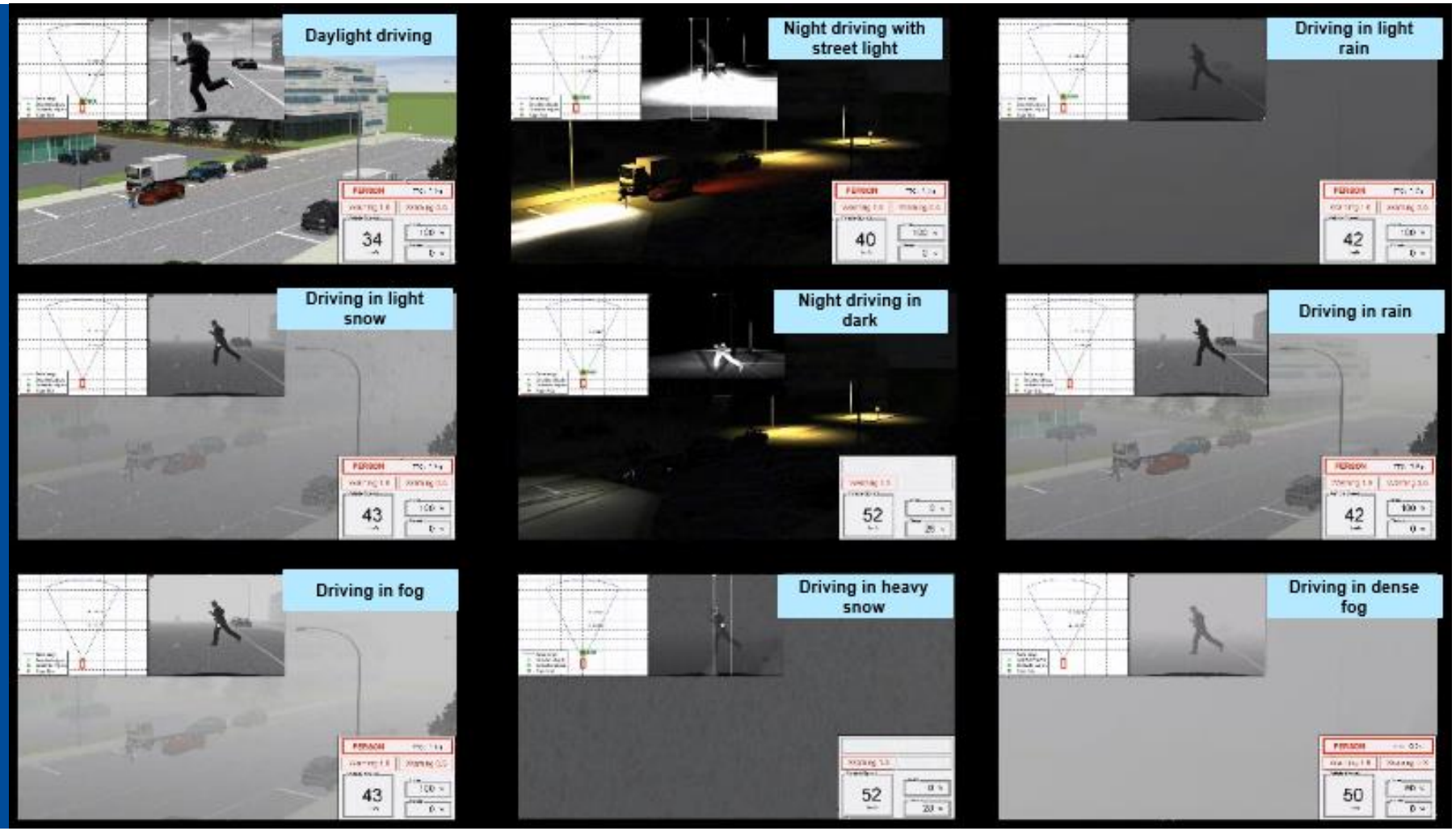
Virtual testing of autonomous driving functions accelerates time to safety goals



- Simcenter PreScan (TASS)
  - —World modeling and scenario building
    - Road sections, bridges, etc.
    - Trees, buildings, traffic signs
    - Cars, trucks, pedestrians
    - Weather conditions
  - —Sensor model library
    - Camera
    - Radar
    - Lidar
    - Ultrasonic
    - Infrared
    - V2X
    - GPS

Verify Many Driving Conditions Virtual Scenario Modeling

Generate synthetic real-world traffic scenario in any weather and time-specific conditions to accelerate training and validation of ML algorithms

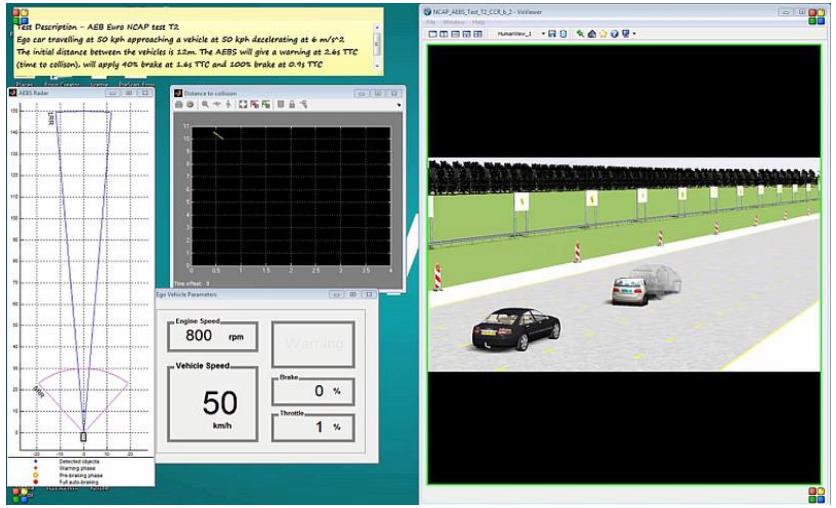


Hardware Emulation is the Ideal Platform for System-of-Systems Verification and Validation

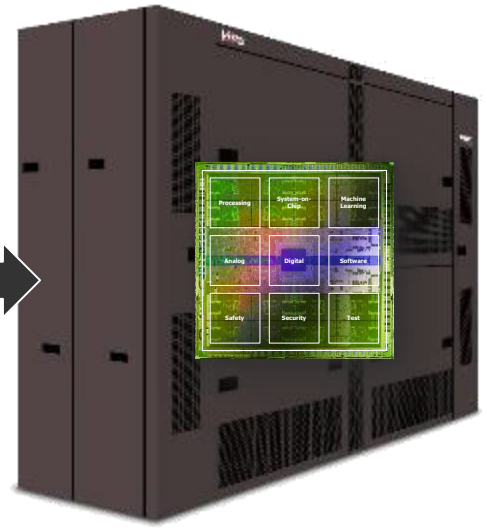
- Veloce is a special purpose supercomputer for modeling digital integrated circuits
- Veloce offers the performance needed for verifying complex electronics parts of the system
- Veloce emulation technology enables new design and verification methodologies from chips to systems

High Performance Solution: Simcenter PreScan with Veloce emulation

PreScan generates virtual driving scenarios and sensor data



Veloce verifies the most complex chip designs



VELOCE STRATO

- Verification of ADAS chips in the context of many different traffic scenarios
- Full design visibility for comprehensive debug of SW and HW and SW/HW interactions
- Fault injection & safety analysis

SENSE + DECIDE = VALUE

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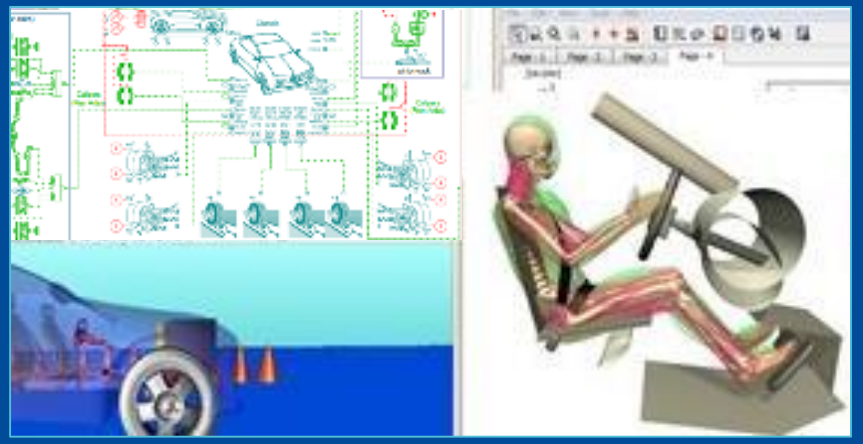
Accurate Vehicle Dynamics Models It's Key

Vehicle Behavior Modeling At the Right Fidelity Level

- Add accuracy to chassis system and tire models to simulate braking and steering behavior and body movements
- Predict body movement and vibrations precisely

Translation of subjective definitions of comfort into objective data



Accurate braking distance prediction

Electronics and Mechanical Must Be Verified Virtually

GIDAS

OpenDRIVE

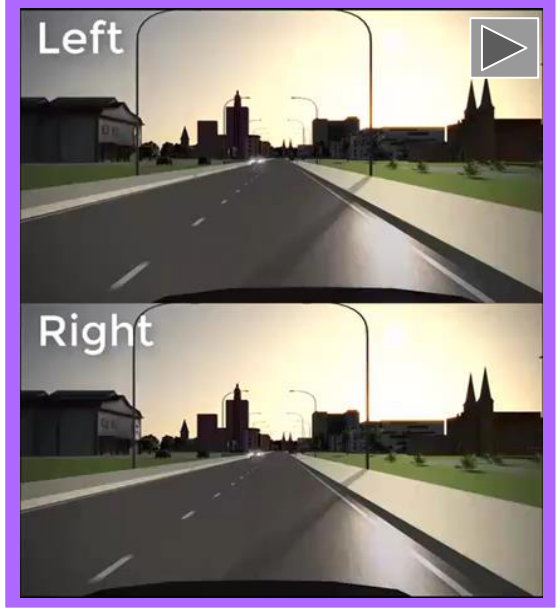
OpenSCENARIO

OSI

Scenario

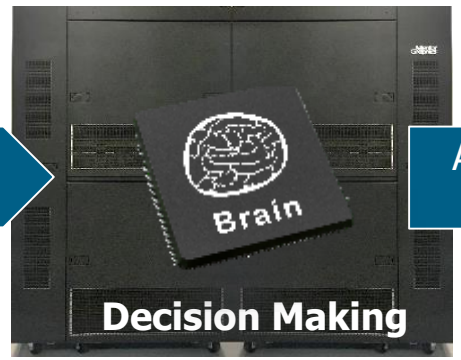
Computer's view

Sensor



DYNAMIC STATE

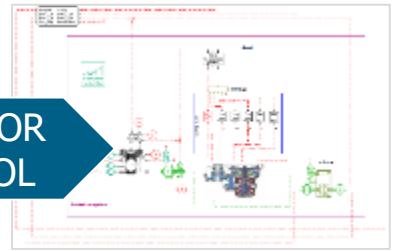
SENSOR SIGNALS



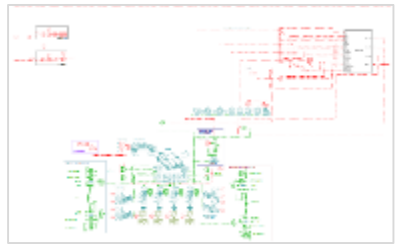
ACTUATOR CONTROL

Vehicle Dynamics Modeling

Powertrain model



Braking model



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Digital Twin Solution Part of the PAVE360 Program

Faster TTM

Reduce development times and increase quality while shortening time to market by shifting left

Greater Efficiency

More efficient and reliable software by providing high-speed virtual platforms long before silicon

Collaboration

Supports geographically dispersed teams collaborating on pre-silicon development and post-silicon debug

Real-time Insights

Track progress to requirements and schedule through incremental metrics for safety, security, power, performance and benchmarks pre-silicon

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