



Verification & Validation for Intelligent Vehicles

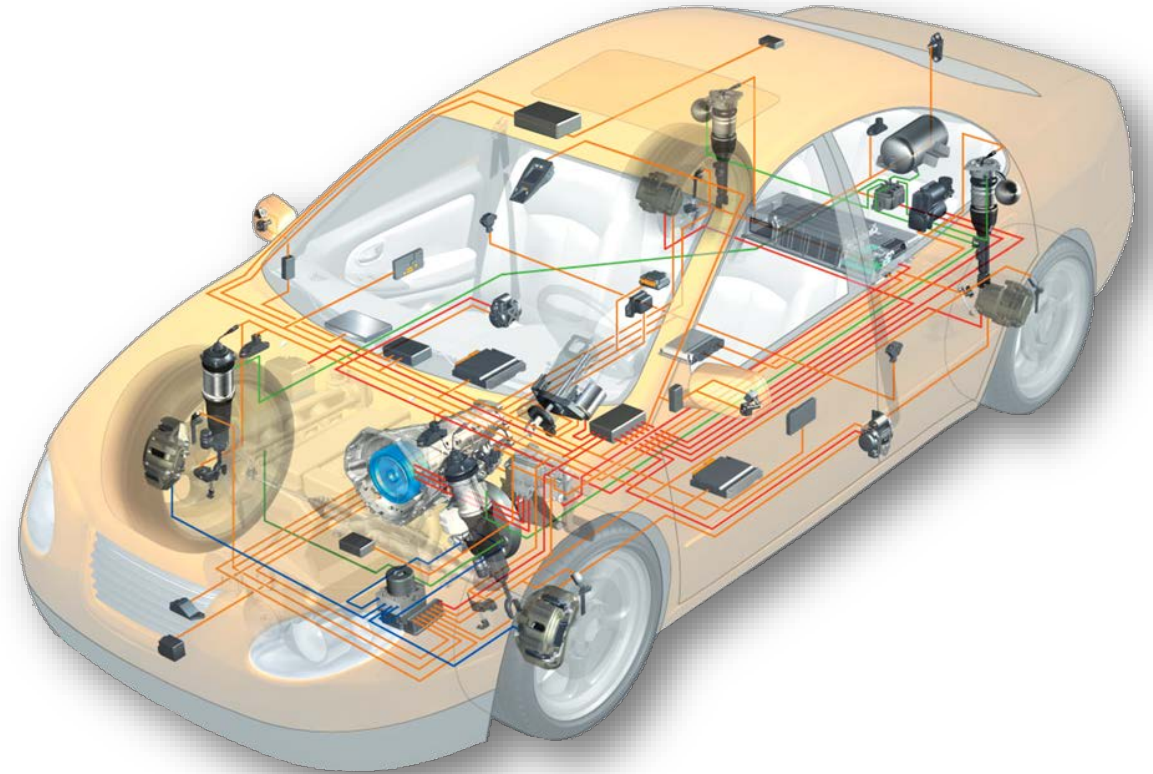
Challenges and Strategy

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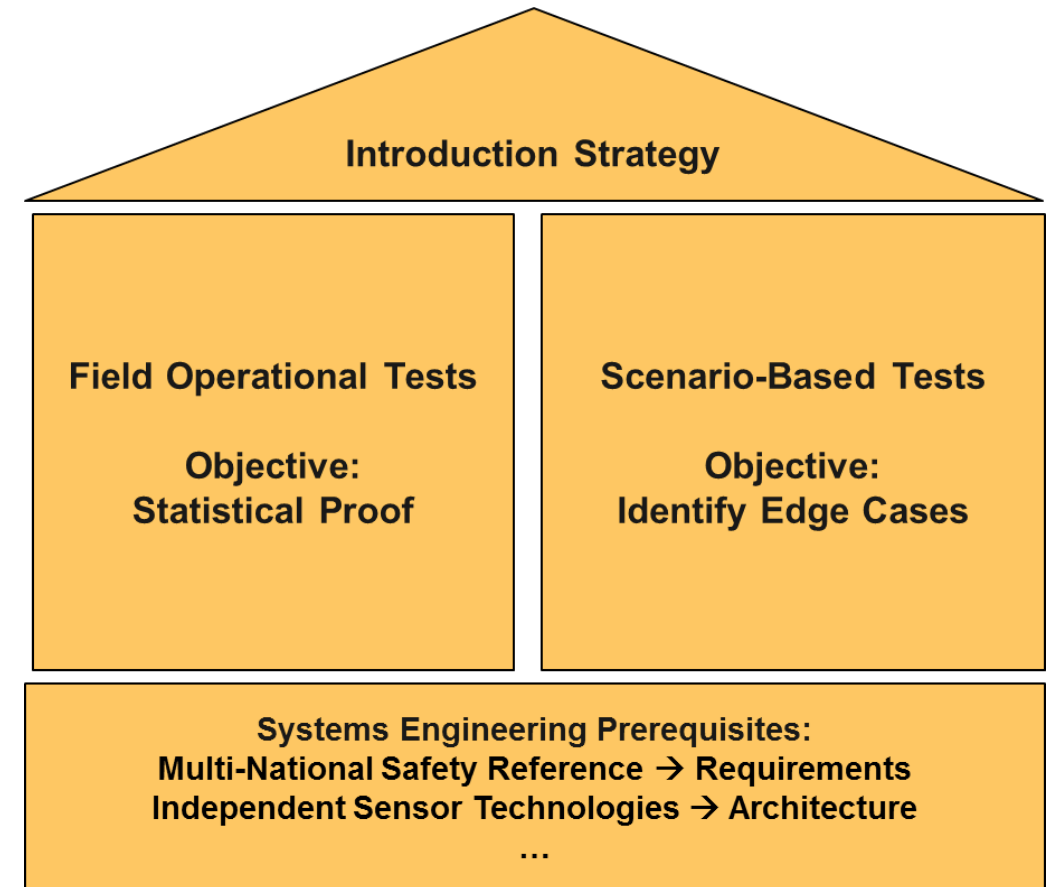
Some Big Picture V&V Challenges for Continental

- › Continental products contribution to intelligent vehicle behaviors
- › A dynamic stochastic driving environment creates uncertainty
- › New modes of vehicle/driver control



A Continental V&V Strategy for Automated Driving (AD)

- › AD is emerging with many functional variations and requirements
- › Our focus is on a holistic AD ecosystem to prepare our components and systems for the multiplicity of ways they will be used
- › Our overall V&V strategy must dovetail with the that of our customers' processes at the vehicle system level



Challenges for Intelligent Vehicle V&V

- › **TEST COVERAGE:** Generation of Scenario-based test cases is knowledge-driven
 - › How do we ensure testing of the most significant, challenging edge cases?
- › **DATA DATA DATA:** Increasing, massive flood of sensing and engineering test data
 - › What data is most relevant and how can we best use it for V&V across lifecycle?
- › **FEATURES:** Sensor suite variations must be highly reliable for feature detection
 - › What are the important features that distinguish driving scenarios?

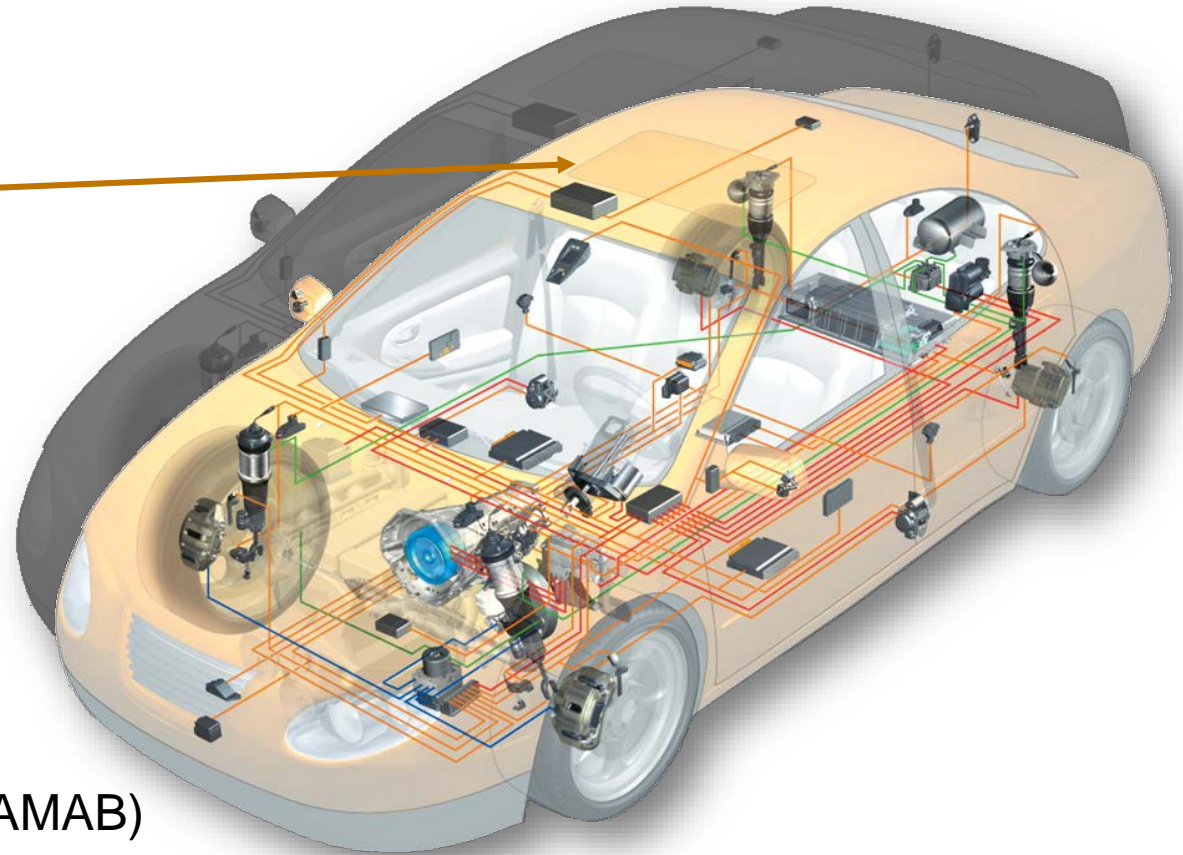
Reducing Risk and Uncertainty at Introduction

› Shadow Mode Features

- › Product introduced as L2 System
- › L3/L4 capabilities operate quietly in background as aid to validation

› Manage uncertainty

- › Conservatively bound use cases to create an ODD *envelope* for AD behaviors
- › Supports compliance with multinational risk acceptance principles (MEM, ALARP, GAMAB)



Future Challenges for V&V of Intelligent Vehicles

- › **SAFE DRIVING:** By either/both the vehicle AND by the human driver
- › **BOUNDARY ENFORCEMENT:** A vehicle will not stray beyond Operational Design Domain
- › **REACHABILITY:** An intelligent vehicle can always reach a minimum risk maneuver
- › **SAFE LEARNING:** Verify the *process* of machine learning as well as what is learned
- › **EMERGENT BEHAVIOR:** Recognize maladaptive behaviors arising from interacting AVs
- › **CYBERSECURITY:** Lock down cyber vulnerabilities of the “Connected Vehicle”

Thank You!

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