

miniHIL Overview – HIL Tests on developers desktop

# AURIX<sup>TM</sup> Knowledge Lab 2021

miniHIL Overview - HIL Tests on developers desktop



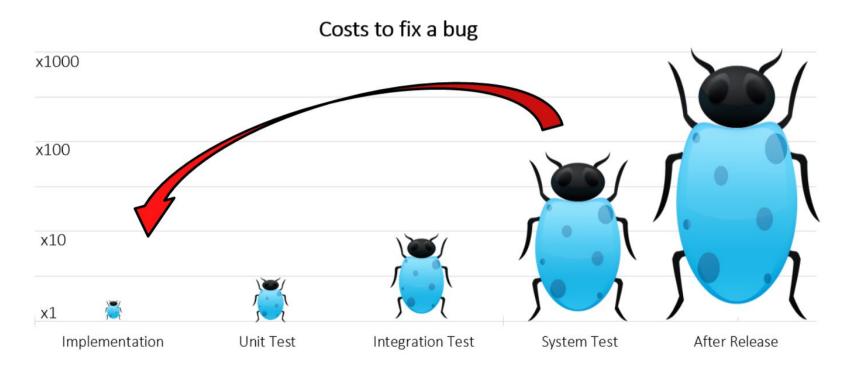


Michael Weiß
Senior Account Manager
Embedded Solutions

michael.weiss@hitex.de

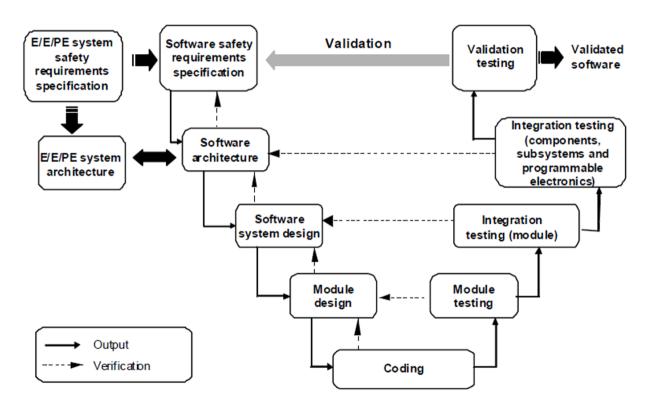
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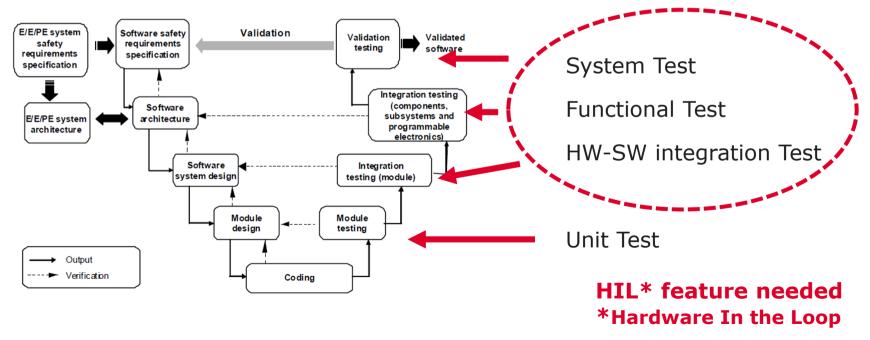




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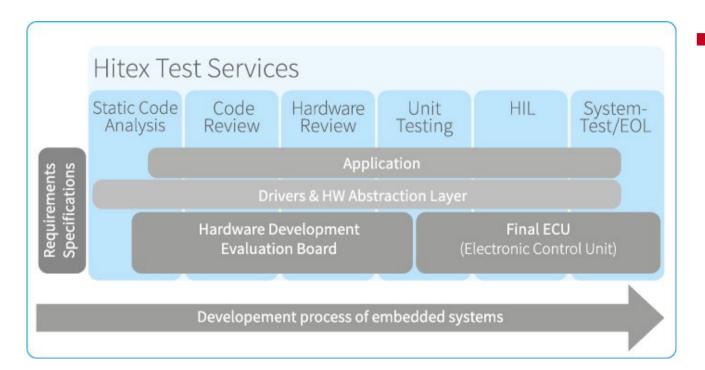


# Quality SW development and safety standards are demanding test & validation on the right side of the V-Model



# Testing is essential ... but often done to late





- Tests are mandantory according to FuSa-standards:
  - ISO 26262
  - □ IEC 61508
  - ☐ ISO 13849
  - □ EN 5012x
  - ☐ IEC 60335
  - □ IEC 60730

→ 95 % of the Embedded Projects are not tested in the early phases

# Challenges with conventional HIL solution



- Tool costs are high
- Complexity of tool
- Simulation of complex or dangerous hardware
- Expensive HIL hardware necessary
- Early test without final ECU not easy
- No test on developers desktop

# Todays challenge ...

→ No HIL tests at home possible ... but project timeline will not change

# What is needed to master these challenges?

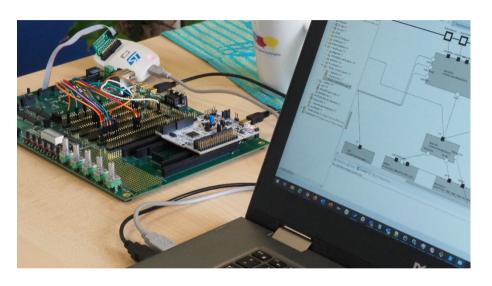


- Real time HW stimulation and measuring
- Support of used interfaces (IO, analog, UART, SPI, I2C, CAN, LIN,...)
- Support of complex protocols (e.g. CAN, LIN, XCP, TCP/IP...)
- Simulation of complex real time hardware (Sensors, Batteries, Components like RAM, Flash,...)
- Test of Motor Control Software (e.g. BLDC motors, sensorless, with sensors)
- Hardware Abstraction Layer (HAL) Test
- Definition of test cases
- Automatic execution of test cases
- Protocolling of test results
- Continuous Integration (CI) possibility
- Achievable prices
- Last but not least ...
- → We need a portable and budget friendly solution!

### The solution: The PROTOS miniHIL



- No safety or hardware problems:
  - Low voltage
  - No additional hardware, only simulations
- Simple development and test on evaluation boards
- Small enough for desktop
- Inexpensive hardware for every desktop



### Additional Benefits:

- Full test automation from desktop to continuous integration
- Failure injection, not only "happy path tests"
- Full regression testing after after every change
- Simulation based integration- and system-test
- No ECU or final hardware necessary

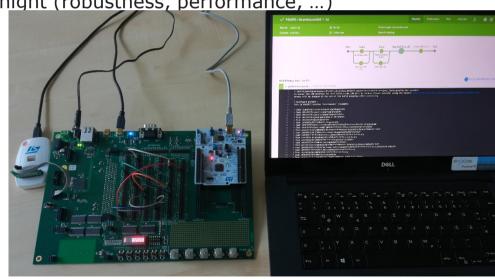
# Continuous Integration for HIL Tests



- Full Hardware in the Loop test automation with continuous integration (CI)
- Every commit for application or test cases triggers test run
- Fail fast: First test results for commit after 5-15 minutes

Deeper tests can run automated over night (robustness, performance, ...)

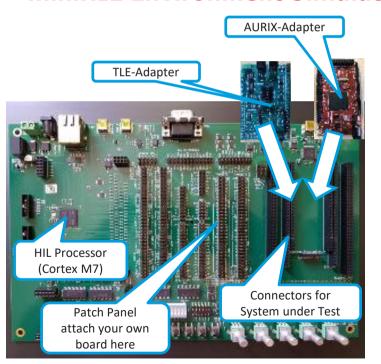
- Automated test reporting
- Inexpensive, small hardware enables CI setup for every project
- Every application or test developer can use the test setup,
   also from home office

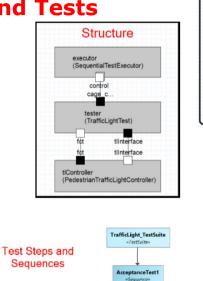


### The solution:



### miniHIL Environment Simulation and Tests



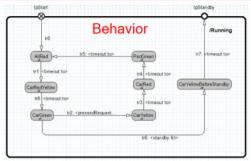


PressButton

Start

«Step»

InitToStandby



### Feature Coverage Report Overview

Result:	FAIL				
Project:	Project1				
Date:	23-08-2017		PASS	Total	Coverage
Rev. Info:		Features:	11	43	25.5 %
Legend:	falling missing leaves passing	Testcases:	2652	2653	99.9 %

Feature	Testcases		
Feature 1		100 %	8/8
Feature 2	1 m	89.4 %	17 / 19
Feature 3		79.3 %	23 / 29
Feature 4		90.9 %	20 / 22
Feature 5		100 %	8/8
Feature 6		65.6 %	21/32
Feature 7		92.8 %	13 / 14
Feature 8		90 %	18/20
Feature 9		85.7 %	6/7
Feature 10		80 %	12 / 15
Feature 11		68.4 %	13 / 19
Feature 12		90.6 %	29 / 32
Feature 13		83.3 %	5/6
Feature 14		75 %	3/4
Feature 15		100 %	9/5
Feature 16		82.7 %	24 / 29
			40

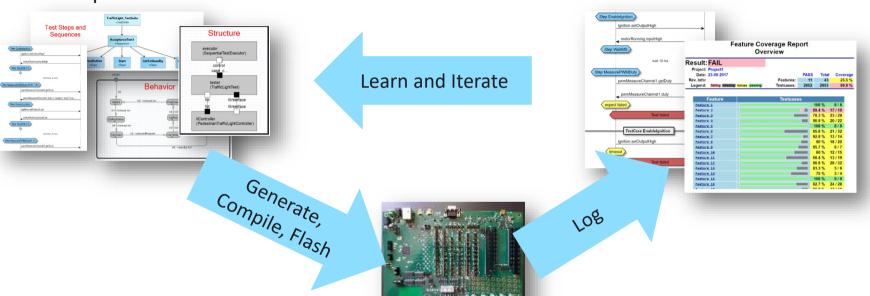
CheckingMainSequence

# The miniHIL Test Development Process



3. Analyse Test Reports and Traces

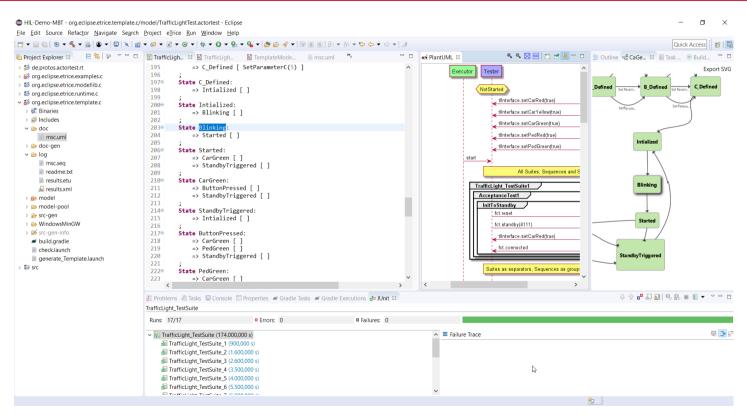
1. Develop Simulation and Test Models



2. Execute Simulation and Tests on miniHIL

# miniHIL - Graphical Test Generation









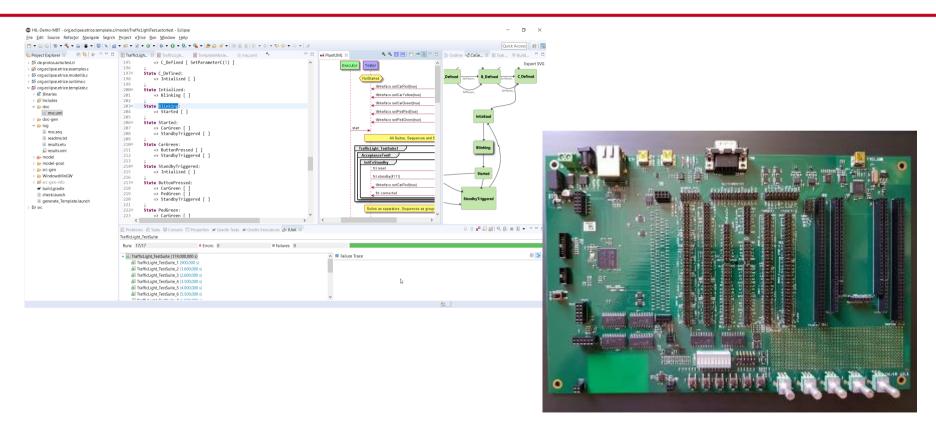
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Feature 3	7	9.3 %	23 / 29
Feature 4	9	0.9 %	20 / 22
Feature 5	1	00 %	8/8
Feature 6	6	5.6 %	21/32
Feature 7	9:	2.8 %	13 / 14
Feature 8		90 %	18 / 20
Feature 9	8	5.7 %	6/7
Feature 10		80 %	12 / 15
Feature 11	6	8.4 %	13 / 19
Feature 12	9	0.6 %	29 / 32
Feature 13	8	3.3 %	5/6
Feature 14		75 %	3/4
Feature 15	1	00 %	9/9
Feature 16	8	2.7 %	24 / 29
	- 0	20.00	40.44

### No time for miniHIL Demo here ... contact us ©





# Price Indication (10.2021)



	miniHIL Software Licenses and Features			
miniHIL Features	Developer License (Node Locked)	User License (Node Locked)	Continuous Integration Server License (Node Locked, max. 4 Cores)	Target License (per miniHIL Board)
CaGe - Test Modeling and Test Generator	х			
miniHIL GUI	х	х		
Test Reporting and Traceability	х	х	Х	
Build and Test Automation	х	х	Х	
eTrice (Open Source) - Modeling for Simulation and Monitoring	х			
miniHIL Target Framework				X
Software Price				
License Price	12.000 €	4.000 €	10.000€	1.000 €
Maintenance Price (20% of License Price per year)	2.400 €	800 €	2.000 €	200€

miniHIL Hardware	Price
miniHIL Board 2.1 (requires one Target License per Board)	2.000 €
miniHIL Target Adapter Boards for specific Microcontrollers	price on request
miniHIL FPGA Extension Board	price on request

# Starting a miniHIL project



- We support you throughout the entire miniHIL implementation process
- Detailed consulting based on your use cases
- Initial workshop with concrete benefits for you based on your requirements
- Implementation of pilot project(s)
- Project accompanying test services

# Our Services: Initial miniHIL Workshop



# Agenda

- ☐ Introduction into miniHIL based on customers test requirements (e.g. current system/software architecture, current test methods, test objectives, gaps, ...)
- Overview of test possibilities with miniHIL on the basis of a concrete demo project.
- Development of test objectives and boundary conditions
- □ Definition of system boundaries, interfaces and performance characteristics
- □ Definition of next steps

# Results of the workshop

- ☐ Test objectives and boundary conditions
- Conceptual design for a pilot project (specification)
- □ Definition of acceptance tests
- ☐ List of next steps and priorities
- ☐ Clear insight into the advantages and values of using miniHIL

### ■ Time Invest

□ 1-2 days onsite or WebEx

# Our services: pilot project



# Pilot Project Definitions

- ☐ The type and scope of the pilot project will be defined during the initial workshop.
- ☐ The scope of the pilot project includes
  - · Implementation of test cases on a jointly defined customer project
  - Installation of hardware and software incl. electrical wiring for device-under-test (DUT)

### Procedure

- □ During the pilot project, a test setup relevant to you will be developed, which will already be of use to you and will enable you to assess the further use of miniHIL technology.
- □ During the workshop, training on the basics of miniHIL hardware and software will be conducted on your test setup.
- You will be able to work with the test system during the pilot project and receive remote support from Hitex.
- ☐ At the end of the pilot project, the test setup is handed over in the form of a two-day workshop.
- Invest: on request / based on outcome of Initial miniHIL Workshop

### Our services



- Test-Consulting
  - □ Based on standards (e.g. IEC 61508, ISO 26262, ISO 13849 ... )
  - ☐ Test strategies for static and dynamic testing and system integration
  - ☐ Test strategies during development
  - □ Writing testable code
  - ... and much more
- Implementation of miniHIL tests based on your specification
- Project accompanying consulting
  - □ Direct access to miniHIL experts during your project
- Training

### Our Conclusion



### The miniHIL enables early Tests:

- controller Systems Tests
  er Development Tests (HAL / AUTOSAR-MCAL)
  proponent Tests for Motor, Battery, Protocols and other Elements
  integration Tests for Drivers, Components and Application on Target CPO with IO-Signal
  Test for complete Microcontroller Applications (HIL System Tests) without additional HW

  Test for Environment Simulation and Test Cases

  Test Cases

### Features:

- Test your Microcontroller Applications early and automated!
- You can perform HIL tests on your desktop and at home as well ©

# AURIX™ Knowledge Lab 2021













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# Thank you for your attention! Please contact me ...



Michael Weiß
Senior Account Manager
Embedded Solutions

michael.weiss@hitex.de









