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ECU Diagnostics in HIL Applications

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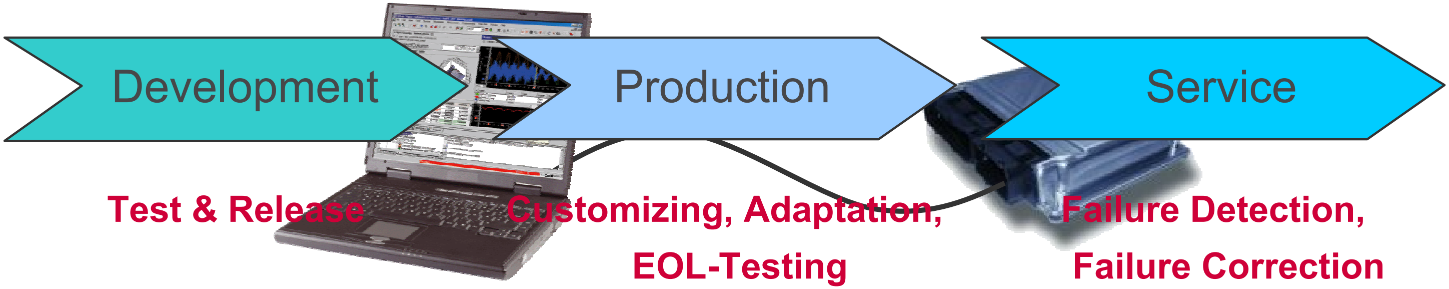
Content

- ECU Diagnostics – Some Basics
- Automated Testing of ECU Diagnostics using HIL
- ECU Diagnostics as an Auxiliary Means in HIL
- Applying ASAM Diagnostics Standards in HIL
- Practical Problems
- Solution Approaches
- Summary and Outlook

Role of ECU Diagnostics



Development

Production

Service

Test & Release

Customizing, Adaptation, EOL-Testing

Failure Detection, Failure Correction

- Reading out Failure Memory
- Clearing Failure Memory
- Reading Measurement Values
- Testing of Actuators
- Flashing of new Software
- Coding of Variants
- Identification of assembled components
- Determination degree of damage and abrasion
- Activation of ECU internal test routines

Importance and Complexity of ECU Diagnostics

Diagnostics in Motronic-Systems covers …

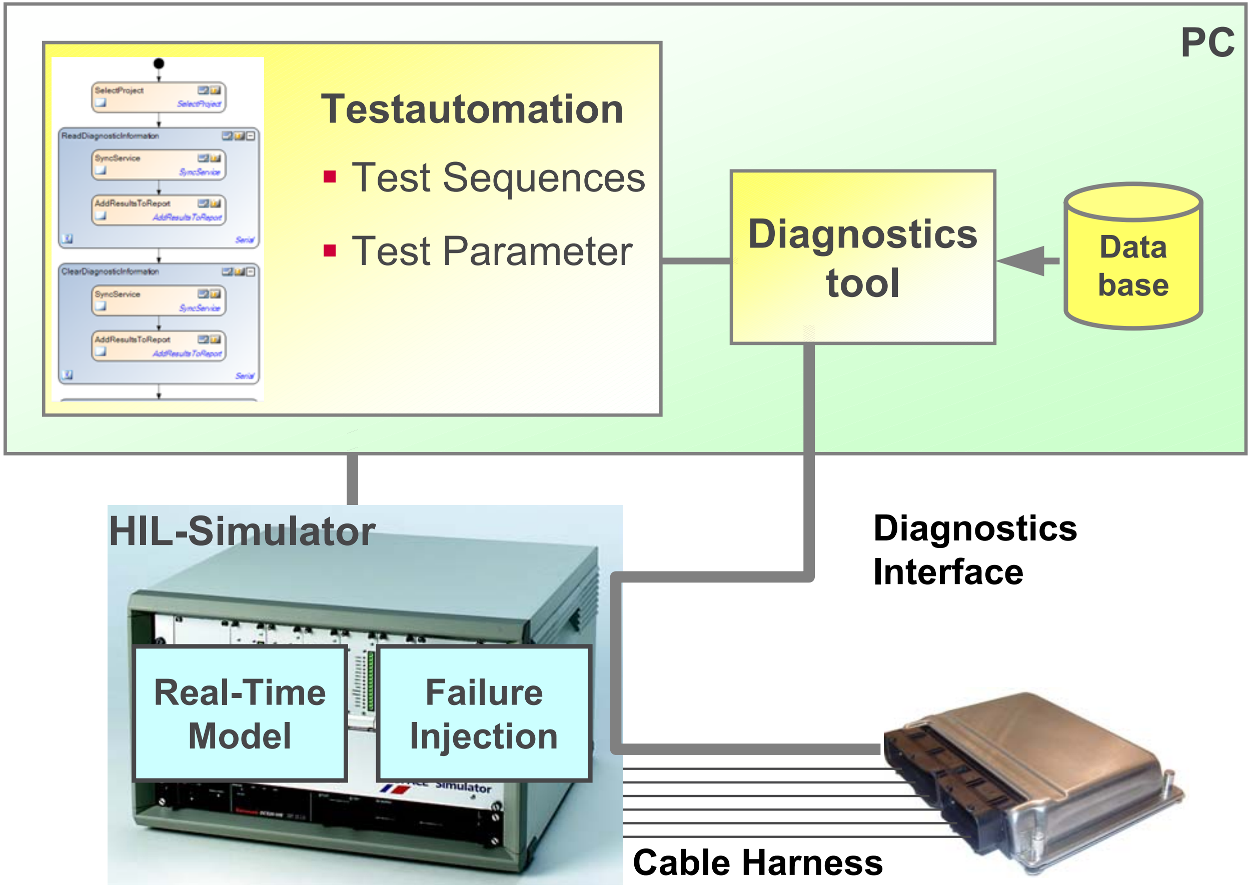
- 40 % of Calibration Parameters
- 40 % of Functions
- 40 % of Lines of Codes
- 40-50 % of Processor Runtime

Source: KLEE, P.; KNIRSCH, M.; WILLIMOWSKI, M.: Herausforderungen der Diagnoseentwicklung in der Motorsteuerung, in: Onboard-Diagnose – Status der Gesetzgebung und Auswirkungen auf die Fahrzeugentwicklung, expert-Verlag, Renningen, 2005

Percentage of ECU Diagnostics test …

- Up to 25 % of overall test costs

Automated Testing of ECU Diagnostics using HIL



PC

Testautomation

- Test Sequences
- Test Parameter

Diagnostics tool

Data base

HIL-Simulator

Real-Time Model

Failure Injection

Diagnostics Interface

Cable Harness

ECU Diagnostics as an Auxiliary Means in HIL

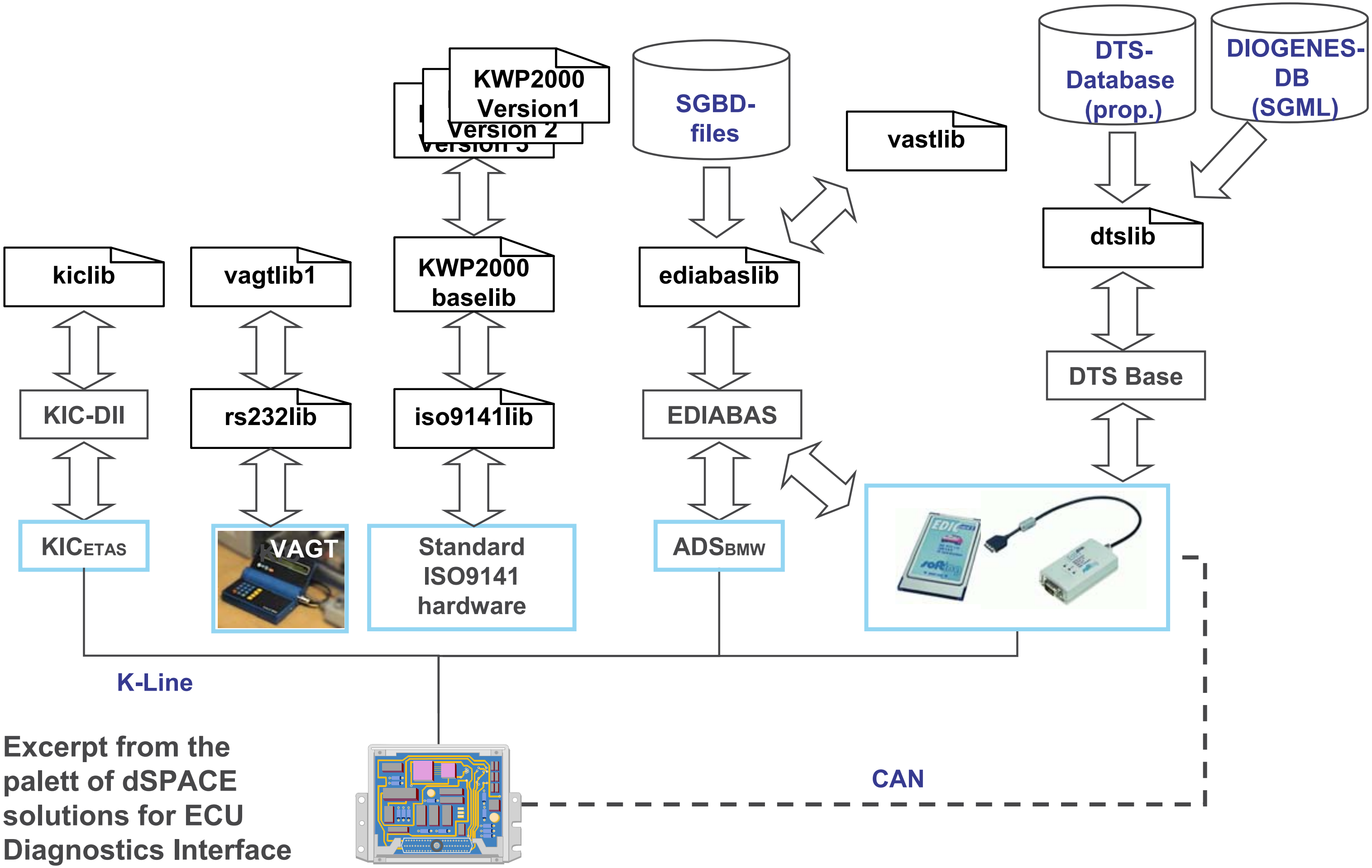
Scenario 1: Putting into operation or reconstruction of a HIL simulator …

- Failure Memory Handling (reading and clearing)
  No failure memory entries == reference operation of HIL
- Coding of relevant variant(s) of System Under Test
- I/O check by activation of actuator test
- Adaptation of assembled sensors / actuators

Scenario 2: Manual or automated ECU diagnostics test …

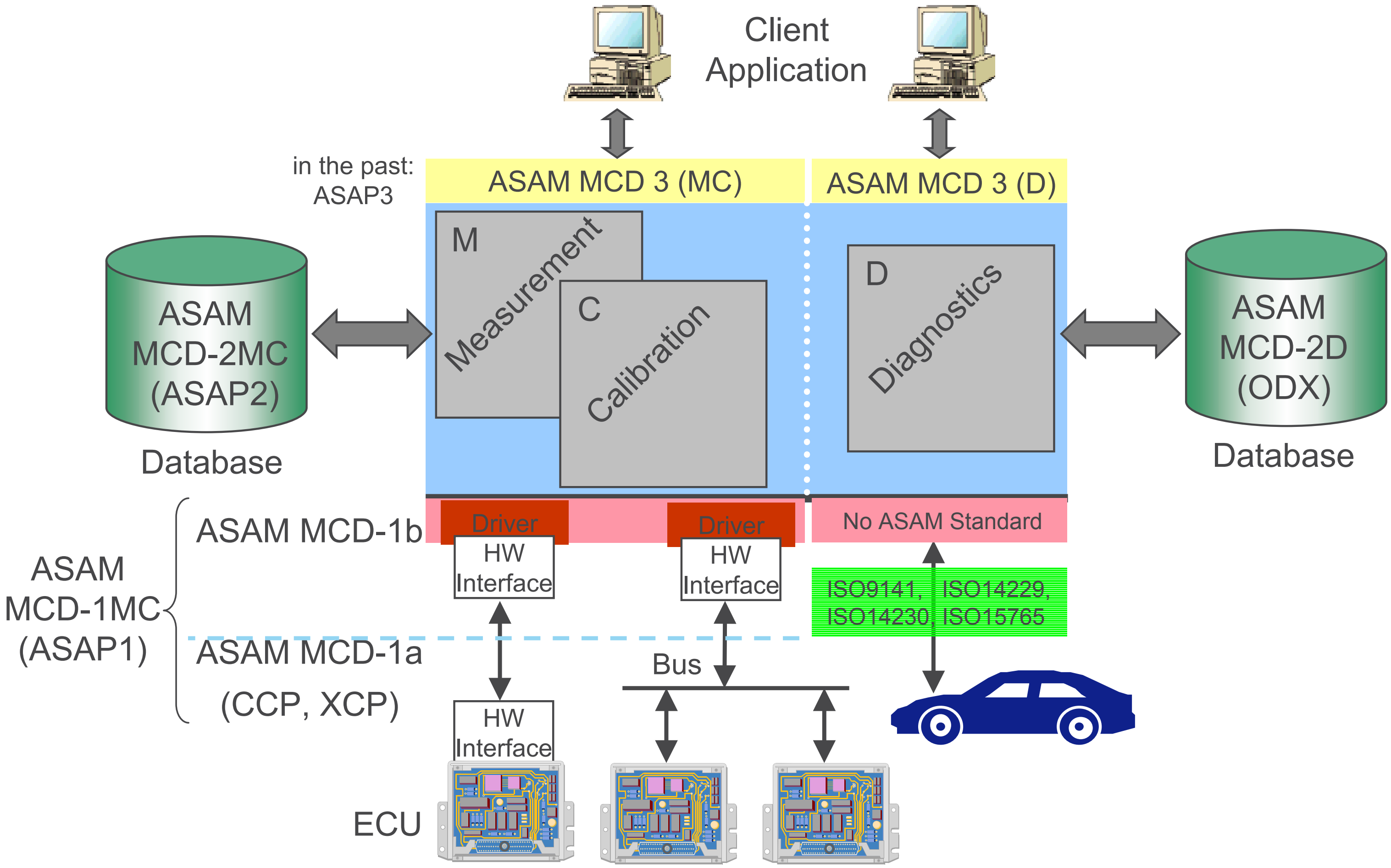
- Identification of System Under Test
- Subsequent coding of relevant variant(s) of System Under Test
- Preparation of error-free starting condition of test sequence by clearing the diagnostic trouble codes
- Reading out measurement values
- Modification of calibration parameters

Retrospection: Diversity of proprietary Diagnostic Solutions

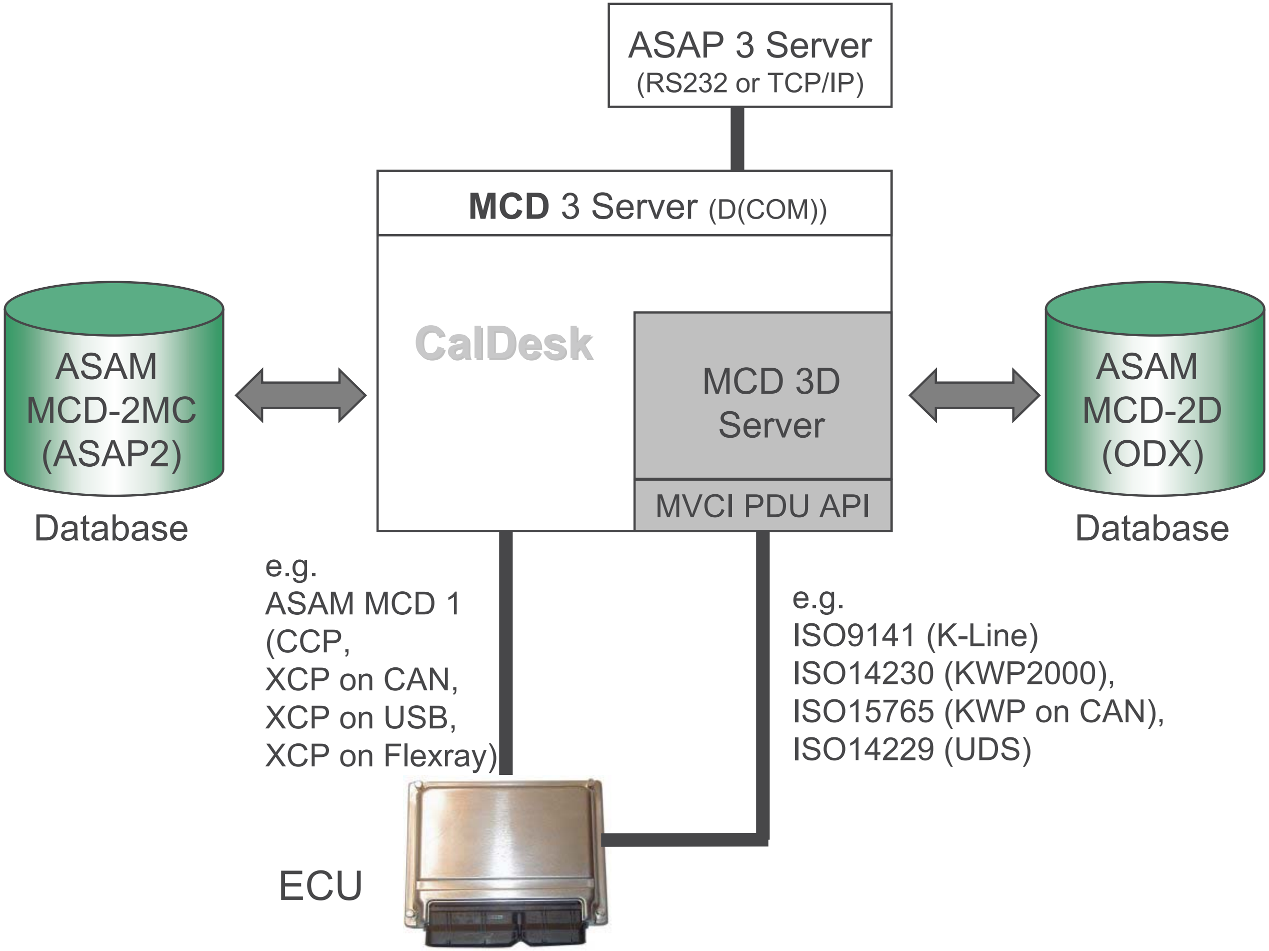


Excerpt from the palett of dSPACE solutions for ECU Diagnostics Interface (Mid 2000)

Existing Standards around ECU Diagnostics



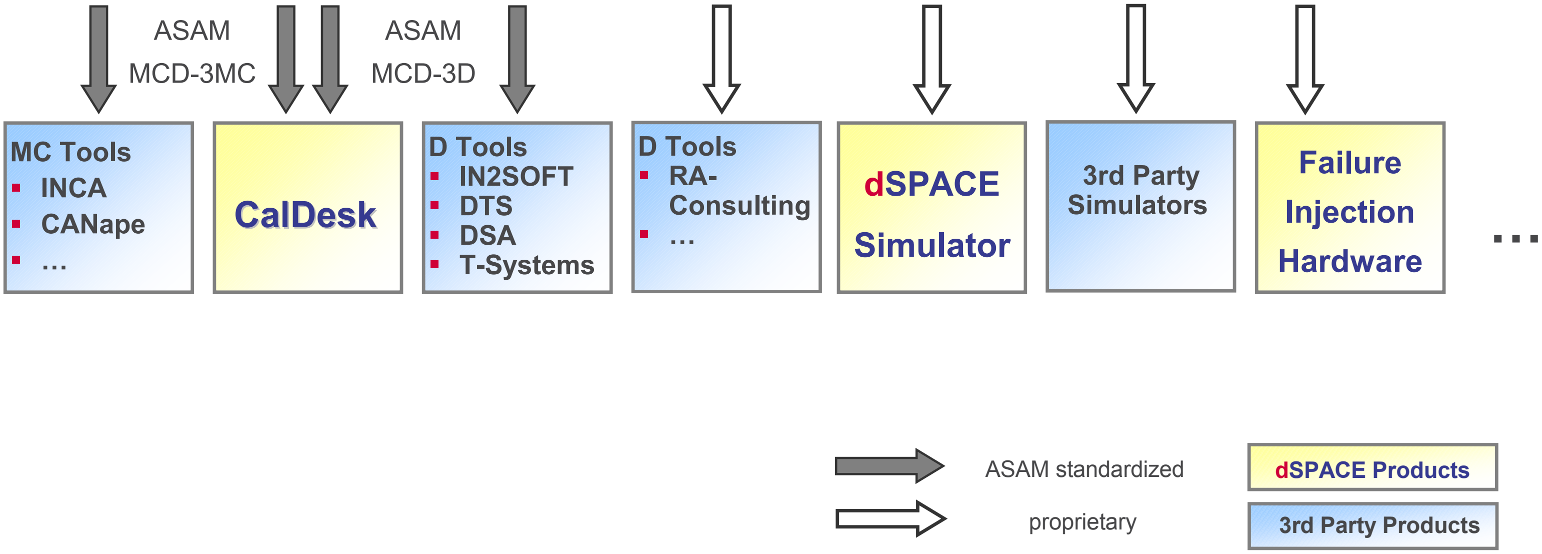
Server side implementation of ECU Diagnostics Standards in CalDesk



Client side implementation of ECU Diagnostics Standards in AutomationDesk

AutomationDesk

- Graphical Testsequences
- Access to interfaces via block libraries
- Management of test projects
- Archiving test results, report generation



ASAM MCD-3MC

ASAM MCD-3D

MC Tools
- INCA
- CANape
- …

CalDesk

D Tools
- IN2SOFT
- DTS
- DSA
- T-Systems

D Tools
- RA-Consulting
- …

dSPACE Simulator

3rd Party Simulators

Failure Injection Hardware

…

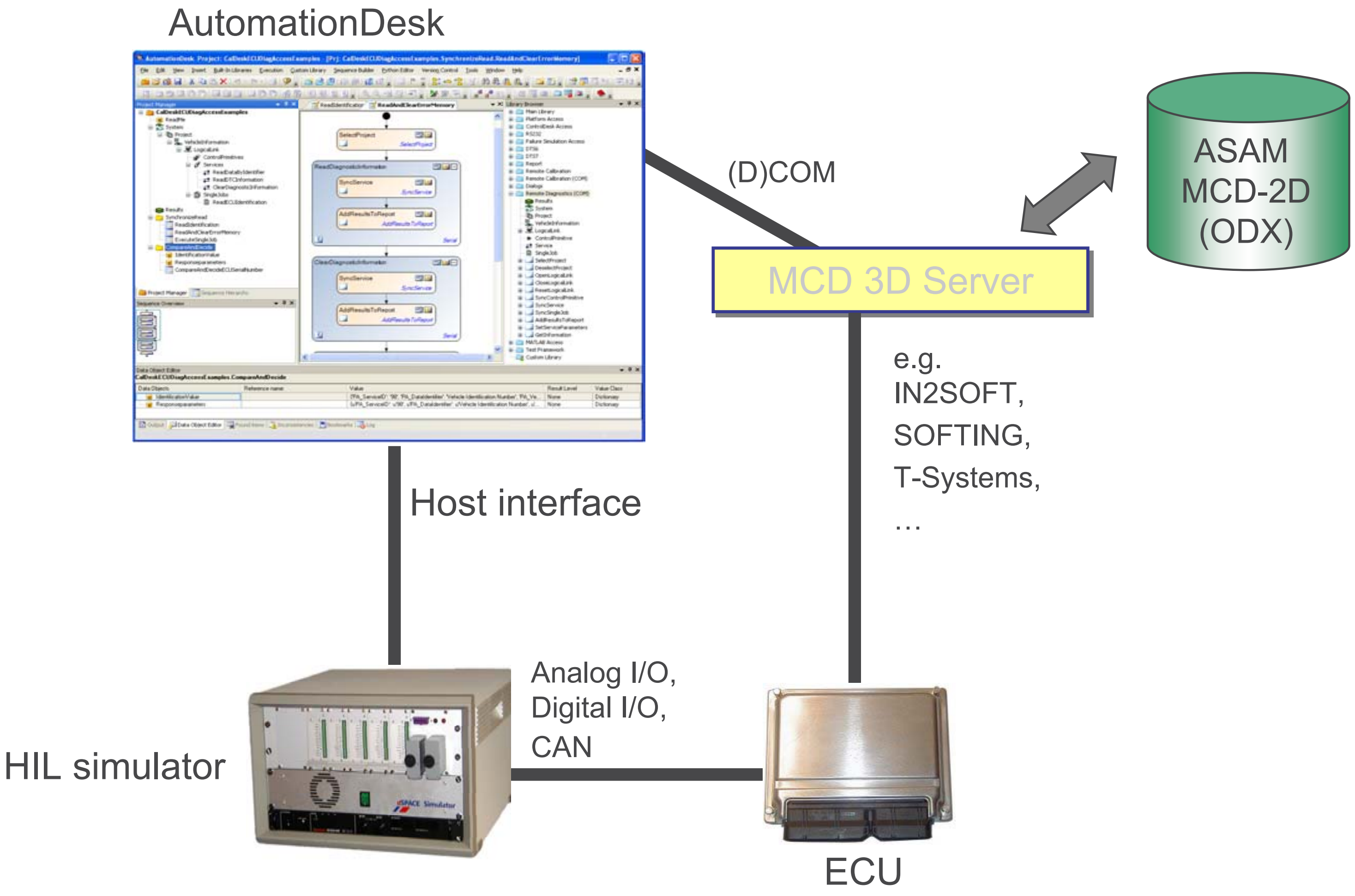
ASAM standardized

proprietary

dSPACE Products

3rd Party Products

Client side implementation of ECU Diagnostics Standards in AutomationDesk



AutomationDesk

(D)COM

ASAM
MCD-2D
(ODX)

MCD 3D Server

e.g.
IN2SOFT,
SOFTING,
T-Systems,
…

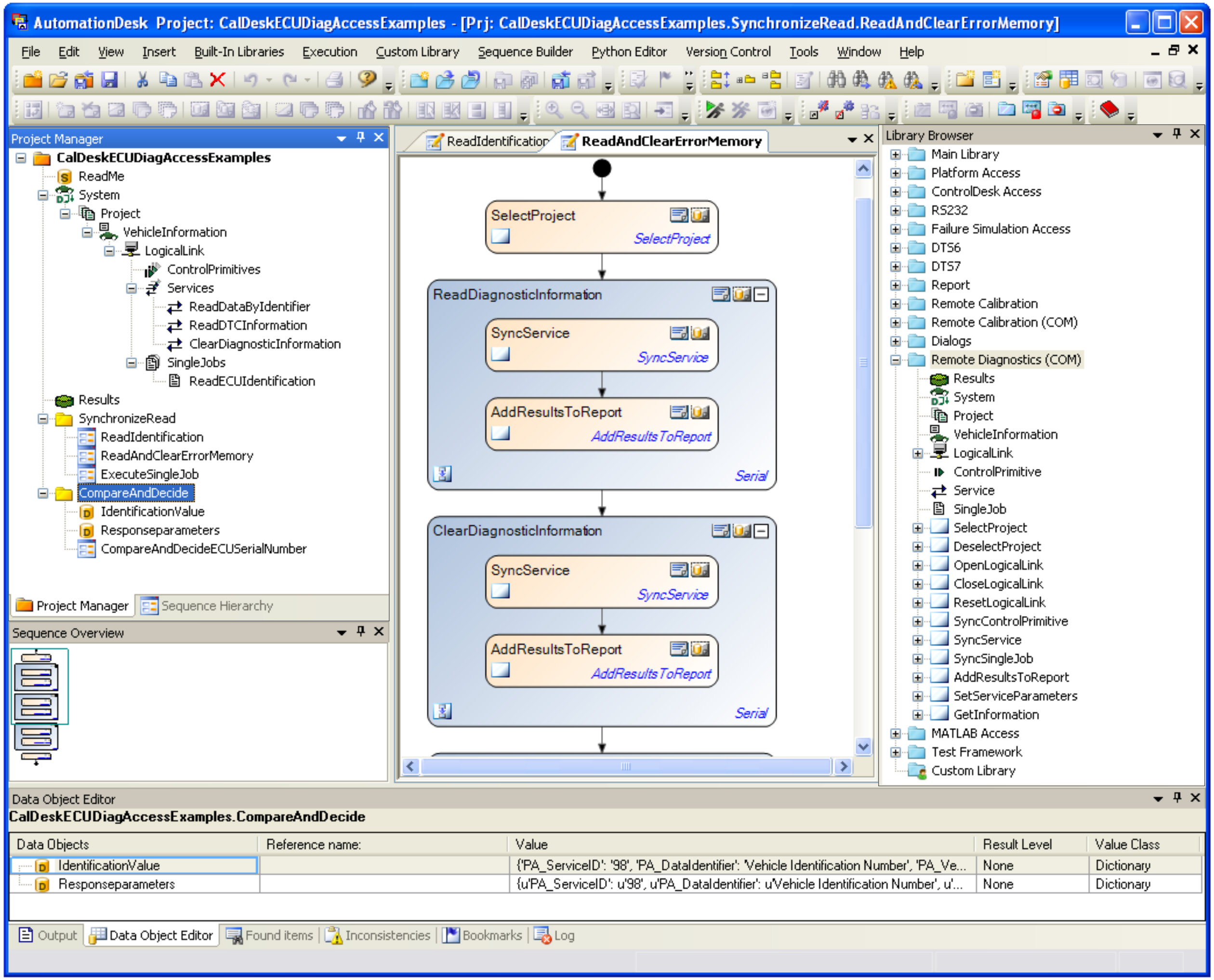
Host interface

Analog I/O,
Digital I/O,
CAN

HIL simulator

ECU

AutomationDesk



AutomationDesk Project: CalDeskECUDiagAccessExamples - [Prj: CalDeskECUDiagAccessExamples.SynchronizeRead.ReadAndClearErrorMemory]

CalDeskECUDiagAccessExamples.CompareAndDecide

Data Objects	Reference name:	Value	Result Level	Value Class
IdentificationValue		{'PA_ServiceID': '98', 'PA_DataIdentifier': 'Vehicle Identification Number', 'PA_Ve...	None	Dictionary
Responseparameters		{u'PA_ServiceID': u'98', u'PA_DataIdentifier': u'Vehicle Identification Number', u'...	None	Dictionary

Practical Problems

- **1. Weak point: Diagnostics Data Bases Content**
  - Still in practise: proprietary data bases
  - ODX complexity, incompatibilities resp. missing semantic clearness
  - Migration
- **2. Weak point: Diagnostics Data Bases Availability in time**
- **3. Weak point: Automation Interface**
  - Still in practise: proprietary APIs, using very different technologies
  - Very complex, very generic MCD-3D API – hard to use for ECU test developers
- **4. Weak point: OEM spefic binaries**
- **5. Weak point: Know-how hurdle between HIL- and ECU diagnostics area**

Solution Approaches

- **1. Weak point: Diagnostics Data Bases Content**

➔ *Freeze ODX in its today‘s version*

➔ *ODX Authoring Guidelines*

➔ *Best practise exchange between OEMs and Tier1*

- **2. Weak point: Diagnostics Data Bases Availability in time**

➔ *ODX Development to follow the entire software development cycle from specification to prototyping to implementation to test*

- **3. Weak point: Automation Interface**

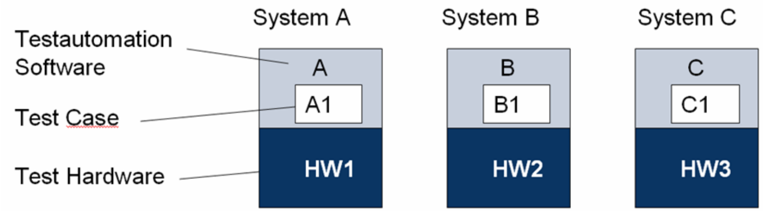
➔ *HIL, i.e test-oriented convenience layer*

➔ *new ASAM HIL-API project (DIAG Port)*

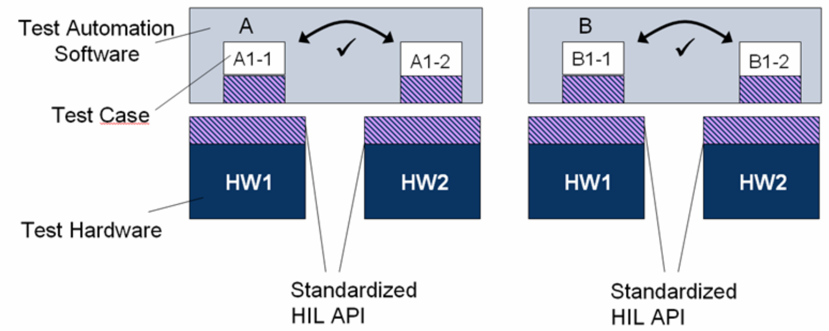
- **5. Weak point: Know-how hurdle between HIL- and ECU diagnostics area**

➔ *ASAM HIL API project (DIAG Port)*

ASAM HIL API project

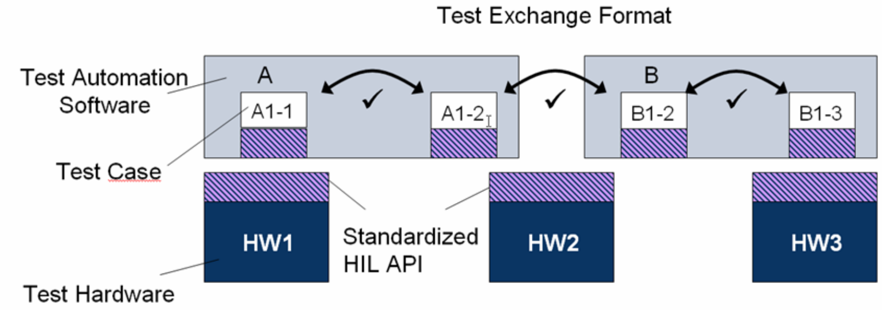


Separated test systems today



ASAM HIL API Goal: Separation of Test HW and Test SW by means of standardized APIs

Future Standardization (under prep.): Exchange of test cases between different software systems by means of a standardized Test Exhange Format



Summary and Outlook

- **ECU diagnostics is a very complex topic**
- **HIL technology is essential for ECU diagnostics testing**
- **ASAM Standards are indispensable for cost-effective test environments**
- **ASAM Standards are indispensable for ECU development processes**
- **Interaction of HIL and ECU diagnostics can be optimized**
- **Very promising new standardization project HIL API will lead to new solutions probably in 2009**

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Thank you !

Important Notice