t-DPLAT©, TATA ELXSI Diagnostics Platform

PREM MOHAN NAIR & SREERAJ A
TRANSPORTATION BUSINESS UNIT
HILS TEAM TATA ELXSI

ABSTRACT

Hardware in Loop Simulator (HILS) is the efficient way of validating Electronic Control units, and of late HIL simulators are heavily being used for diagnostic validations through simulated diagnostic environments. The Diagnostic environment enables developers, engineers and technicians to create consistent diagnostic functions based on international standards as well as to ensure that diagnostic communications of ECUs, and works reliably over the entire value chain. Together, vehicle OEMs and tool manufacturers have specified an international standard for a data-driven diagnostic operating system with standardized interfaces. The data interface defines ODX as data model and universal data exchange format. The application interface permits symbolic access to ECU and vehicle information.

There are many tools and methods are available in the market to implement diagnostic functions using dSPACE Simulators and the t-DPLAT© 'Tata Elxsi Diagnostic Platform' is one such method which provides an efficient way of utilizing dSPACE HIL environment for implementing ECU diagnostic solutions. This paper address the methods of implementing t-DPLAT© over dSPACE Simulator with ODX extraction, and implementation of Diagnostic services automation at Tata Elxsi.

INTRODUCTION

UDS (Unified Diagnostic Services) standard is being widely used for the diagnostic communication among ECUs. Diagnostic functions in the ECUs will serve to identify unexpected behavior within the ECU and its environment, and to benchmark, to record these in the fault memory. From there, the entries can be selected and processed through an external test system. t-DPLAT© is an diagnostic platform to address such diagnostic functions.

When off board diagnostic functions are developed in parallel to the ECU software, they can be tested at an early stage of development. t-DPLAT© facilitates ECU diagnostics and flash programming compliant to the OBD & ODX standards. t-DPLAT© allows validation of diagnostics services prior to the hardware availability.

t-DPLAT© ARCHITECTURE:

t-DPLAT© is a combination of multiple capabilities implemented through a MATLAB/Simulink environment, Microsoft Visual Studio environment and Python scripts, algorithms like timing checks and flow controls are implemented through Matlab/Simulink environment. t-DPLAT© will operate on dSPACE HILS software 'ControlDesk' to access HILS CAN interfaces to establish interaction with the ECUs, a model part of the t-DPLAT© will be running along with the HILS plant model. The software part of the t-DPLAT© will access the model running inside the simulator and extract relevant information using python functionalities.

t-DPLAT© is implemented with an internal database of ISO-14229 based diagnostic services, and ODX extraction function helps user to get all the ECU specific information provided by the ECU vendor, which will ease the generation of test cases for diagnostic validation.

'.DBC' file extraction method (keeping Vector CAN DBC file format as standard), which would identify ECU(s) that are present in a network by finding ECU's communication identifiers.
t-DPLAT© has provisions to accommodate user specific security seed key algorithms..

The following figure illustrates the applicability of the tool during the various development/Testing stages.

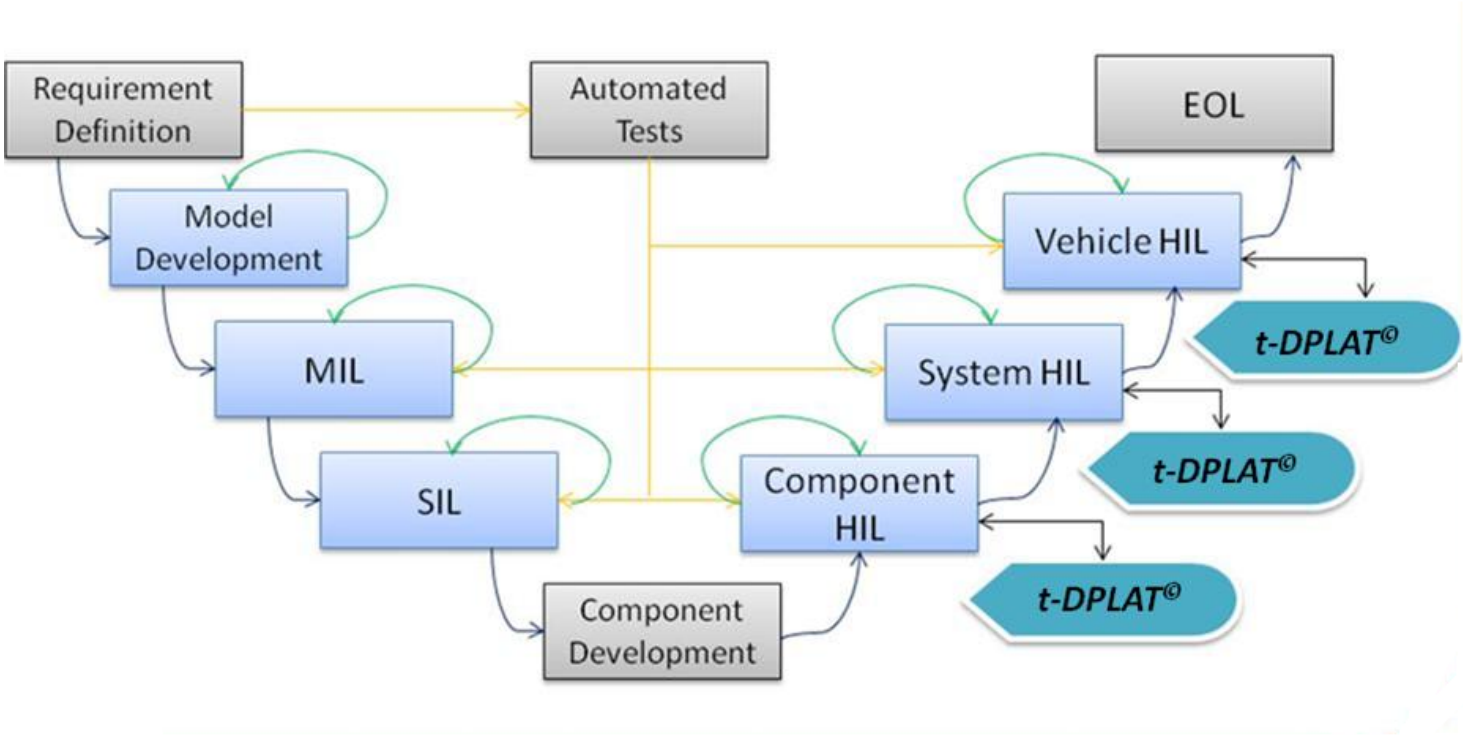

Figure 1: Application of ***t-DPLAT***©

The CAN interface configuration for the diagnostic operation is achieved through an automated process by the t-DPLAT© through the .DBC file extraction algorithm.

Timing algorithm which is implemented in the Matlab/Simulink environment will take care of all standardized timing requirements. Flow control, P2, P3 timing requirements of UDS protocol are addressed by this algorithm, which provides accurate results through real time data analysis. Non-compliance of any timing requirements will be reported back to the user instantaneously with the details of root causes.

ODX extraction algorithm which makes use of an '.xml' based algorithm which will provide a customized use of diagnostic database and this database will allow efficient interpretation of diagnostic results, which are easy to comprehend. Also it is made easy to generate diagnostic test cases for ECU(s) through this ODX extraction algorithm.

TOP LEVEL ARCHITECHTURE

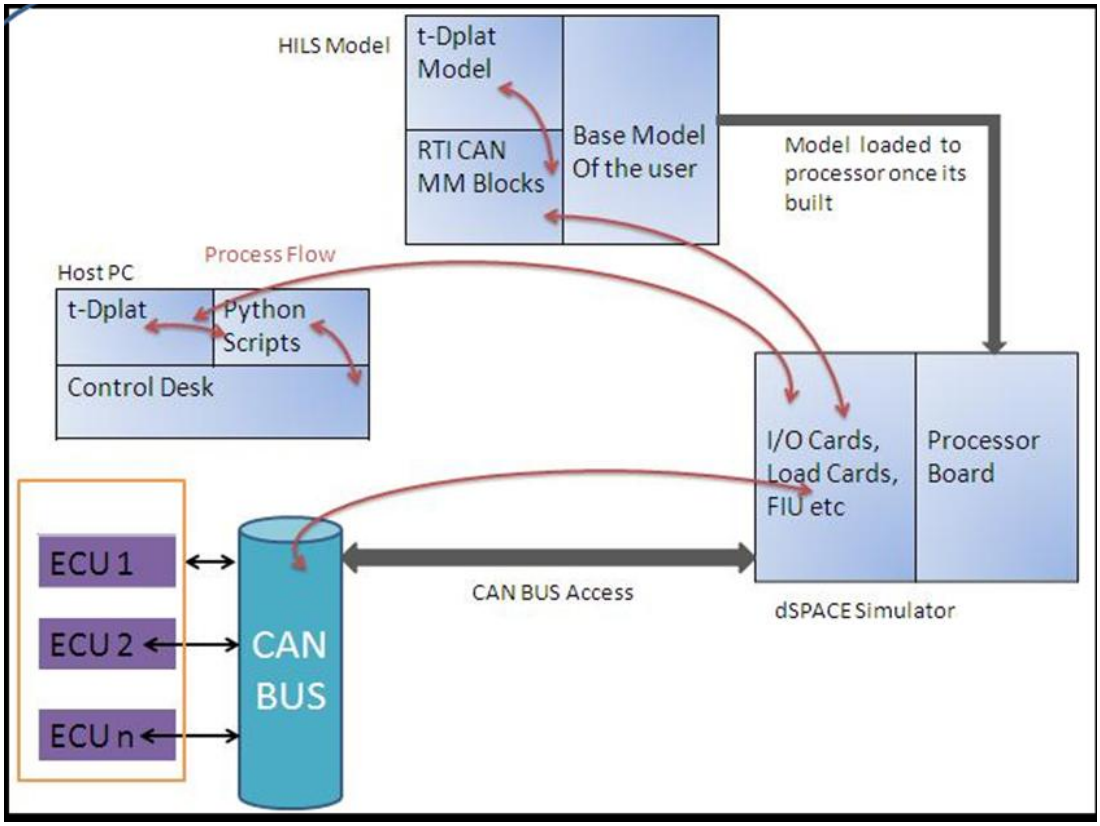

Figure 2 : Top Level Architecture

Capabilities

- Diagnostic Data reading
- ECU Flash programming
- ECU Routine control.
- ECU Input/output control

Benefits

By implementing t-DPLAT© in Tata Elxsi,

- Achieved effort reduction through automation of test cases.
- t-DPLAT© method found to be an easy way of reproducing test conditions
- Effective and efficient data verification and early detection methodologies and debugging of ECU communication problems and function errors made easy.

- Avoided dependency on Off Board diagnostic hardware.

Matlab/Simulink based Timing algorithm found to be efficient way of implementing flow controls and other timing requirements with high accuracy, and which will ease portability of the algorithm over different environments.
Implementation UDS database reduced manual test execution efforts to a large extent.

Supported standards

ISO 14229 (UDS)
ISO 15031 (OBD)
ISO 15765(UDS)

System Requirements

dSPACE Full Size or Mid Size Simulator
dSPACE ControlDesk 3.7.1 or higher
Matlab 2006 or higher
Python
.NET Frame Work 4.0 or greater
PC with,
- Processor clock ≥ 1.5 GHz – depending on the system configuration and size of the ODX database
- RAM:
- ≥ 500 MByte for Windows XP
- ≥ 1 GByte for Windows 7
- Screen resolution:
- LAN port

Operating systems

Windows XP (32-bit, SP3) and Windows 7 (32 + 64-bit, SP1)

CONCLUSION

Each year, automotive vehicle systems are becoming rich in functions as witnessed by large number of ECUs and further enhancement in ECUs. And new standards and regulations demands ECUs to come up with robust and dedicated diagnostic functions in each of these ECUs.

With the enhancement of diagnostic functions in automotive vehicles, there comes the demand for higher and reliable validation methods to prove the diagnostic capabilities of ECUs, which is duly addressed by the t-DPLAT© method.

References

http://www.asam.net/

http://www.iso.org/iso/home.html

CONTACTS

PREM MOHAN NAIR (premnair@tataelxsi.co.in)

SREERAJ A (sreeraja@tataelxsi.co.in)

DEFINITIONS, ACRONYMS, ABBREVIATIONS

ECU - Electronic Control Unit

ODX - Open Diagnostic exchange format

CAN – CONTROLLER AREA NETWORK

HIL – Hardware In The Loop

SIL- Software In The Loop

EOL- End of Line