

# Canoe Tool for Ecu Automated Communication Testing

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**Abstract-**This paper presents an automated testing of Brake ECU (Electronic Control Unit) – ESP (Electronic Stability Program) communication using canoe tool. Today the number of ECU's in a car is getting more and more. Besides inner ECU to ECU communication, vehicle to vehicle communication is necessary for the efficient way of vehicular communication. The vehicular communication must be highly responsive and accurate. So ECU testing is compulsory to ensure the efficiency and safety of a vehicle. Testing of an ECU in all aspects like mapping and monitoring of the inputs and outputs with other ECU's is important. During testing the simulation of all loads and sensors associated with that ECU must be ensured perfectly. Manual testing of these ECU with all these necessary condition is a time consuming process. Vector Tool (VT) help in this need of automated communication testing of an ECU. ECU inputs and outputs for functionality related testing with CANoe is done through the VT. Other ECUs in a car can be simulated using CANoe while testing ECU is compatible for all development stages, due to its high scalability and flexibility. CANoe testing provides high accuracy, reusability and easy way of testing. This total environment is called as Office Test Bench (OTB) where all these vector CANoe box, power supply, ECU, application container (software build), continuous Test framework, master PC (where CANoe software is installed) all are embedded. This setup makes user to test ECU's very easily and effectively. Basic tests like validation of diagnostic services can be generated automatically in the test configuration tool while complex testing requires manual generation of test cases using script. The test environment is then run on the ECU and a test report is generated for analysis. The test environment is then delivered to a Continuous testing (CT) server and executed on a Continuous test bench (CTB) for every software build. Test reports are stored back in CT server and can be customized to trigger mail at test failure.

**Key Words:** ECU (Electronic Control Unit), CANoe, OTB (Office Test Bench), AUTOSAR (Automated Open System Architecture), CTB (Continuous Test Bench), CT (Continuous Test)

## I. INTRODUCTION

The vehicle system consist of engine, automatic transmission, steering, brakes, navigation, air conditioning and much more system. Earlier these system s are controlled either by mechanical or hydraulic systems. These system are controlled by ECU (Electronic Control Unit)[12], ECU is like miniature computer that takes input from the sensors and perform inter decision logic and control the actuators like electric motors and valves[9]. In initial ages these ECU's works independently and in later age's communication between these ECU was enabled for better working of a vehicle. Initially connection was made through wires, this made the vehicle very bulky, expensive and not reliable. Later bus system communication was established

here the communication is happening through a common bus with a communication protocols [7]. CAN, Flexray is the major communication protocols that is predominantly followed in industries. Communication protocols defines set of rules, how sender and receiver ECU

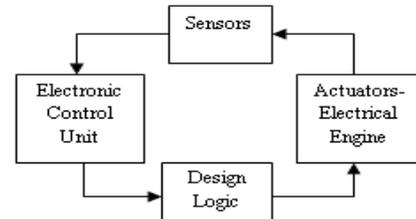


Fig.1 Concept of Electronic Engine

Should communicate. Whenever sender node (ECU) sends a data, it is converted into certain format and then sent to receiver node (ECU) and the receiver should decode the received data in the same way and then process with the data. Bit Serial Data Communication is one of the best way of sending signal information from one ECU to another ECU, here in bit serial data communication the 0 bit is for 0V and 1 bit is for 12V [1][5]. For example, when engine ECU wants to send the torque signal information 75Nm to the transmission ECU, first the 15 Nm is converted into equivalent bit serial data as 1111 and then sent to the transmission ECU, this receiver ECU will decode this bit serial data 1111 as 15Nm and knows the signals value [1].

## II. AUTOSAR STANDARD

AUTOSAR is automated open system architecture defined the standard for the automatic software architecture.

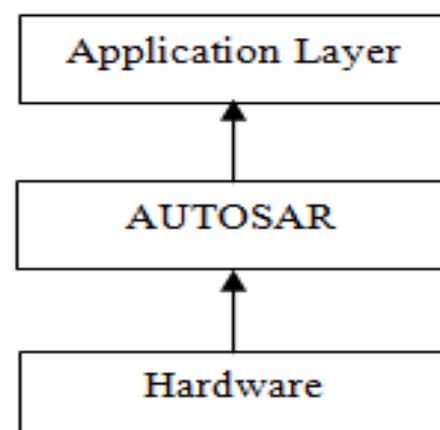


Fig.2 Concept of AUTOSAR

Revised Manuscript Received on December 28, 2018

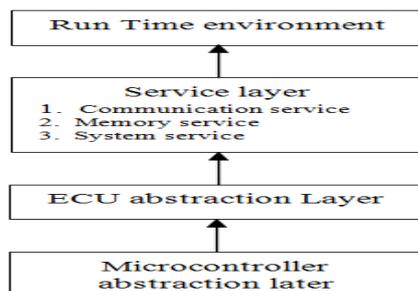
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AUTOSAR is the middle layer between the basic hardware and the outer application layer. In AUTOSAR software components are linked through virtual functional bus (VFB), whenever any software wants to communicate with another component, it first sends the information to virtual functional bus and then bus sends the information to receiver software component. Hence VFB provides great interaction between components and minimize complexity. Input description, System configuration, ECU configuration and Software executables are the four stages in AUTOSAR [2]. AUTOSAR is the middle layer between the basic hardware and the outer application layer. In AUTOSAR software components are linked through virtual functional bus (VFB), whenever any software wants to communicate with another component, it first sends the information to virtual functional bus and then bus sends the information to receiver software component. Hence VFB provides great interaction between components and minimize complexity. Input description, System configuration, ECU configuration and Software executables are the four stages in AUTOSAR [2].

**A. Autosar Layers**

The ECU communication happens in the service layer of the AUTOSAR. Service layer is the highest level of basic software and here ECU [10][11] can access the input and output signals providing the vehicle network communication and program flow monitor. Service layer is a layered architecture and above which it becomes component style. Service provides the vehicular network communication. It provides system service, memory service, communication service [2]. Service layer also monitor the program flow. In the service layer -communication service is at the top level [3].



**Fig.3 Layers in AUTOSAR**

So here at the service layer the communication must be mapped and monitored correctly.

**III. RESULT AND DISSCUSION**

**A. Continuous Build (CT)**

This is the first step in the communication testing process, forms the basis for the testing of the ECU signals. In this step, the software required for testing is first build continuously and then application container is build which has the a2l file. This software a2l file has to be flashed before performing any continuous test [6].

**B. Continuous Test (CT)**

In this step, there are two stage:

First stage – Unpack the software that is continuously build required for testing and preparing the software for flashing.

Second stage – Call the continuous test remotely into the office test bench and execute the hardware CTB rack, here testing [8].

**C. CANoe**

CANoe is a well suited and accurate software tool for ECU and bus simulation, analysis, and test automation. In CANoe the overall system is shown graphically with the CAN bus and all network nodes. CAPL scripts are used to prepare test cases and test list [7][8]. CAN database can be easilty attached with CANoe tool. Start the measurement and CANoe will immediately begin to transmit the message cyclically configured in the generator block.

**D. Continuous Test Bench (CTB)**

In this step, there are three stages:

First stage – Artifact Repository, here the application container is first unpacked and the required software is flashed and then CT framework which has all the test case and the list of test cases to be tested is unpacked and then finally all these information are taken into the CANoe testing environment for testing. Second stage – CTB Rack, here there are many shelf and in each shelf one ECU is connected. So if Brake ECU want to communicate with the Engine ECU and then with the Transmission ECU we can easily able to communicate with each other [5]. Instead of manually switching between these ECU’s we can automatically switch between these ECU’s through CAPL scripts. Third stage – Finally the test result are uploaded and preserved, generally the test result in XML/HTML format.

**IV. CONCLUSION**

The automated test environment using CANoe tool portrayed in this paper have become a necessary step in the development process of the ECU. Testing ECUs with the simulated environment to which it is going to be attached even before the production of the component will reduce the failure rate and cost of production. CANoe tool provides accurate measurement and test results. The test cases are automated same as test cases that are embedded in a project which can be loaded from the test configuration tool and can be run in the same way as manually created CAPL test cases [6]. Using this reports can be easily generated and documented during all the developmental stages of the ECU design.

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