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A Review on Conformance Testing of CAN and LIN Protocols

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Abstract: ***Serial Communication protocols are CAN and LIN. CAN and LIN Conformance test is about testing the process, product or a service that meets the requirements of a specification of CAN and LIN protocols. CAN protocol enable faster communication between electronic devices and modules in vehicles while it reduces the amount of wiring necessity. The LIN protocol serves an important role in providing low-cost feature expansion in modern vehicles. LIN nodes are typically bundled in the clusters, each with a master that interfaces with the CAN bus. These CAN and LIN protocols are interconnected to each other through gateways. Gateways are the one which exchange the messages between CAN and LIN. Without CAN and LIN protocols, automation of the industry would be more difficult.***
Keywords: CAN, LIN, Gateways, Conformance test and Automation.

I. INTRODUCTION

CAN and LIN protocols are mainly used in automotive industry. CAN protocol was developed by the Bosch in 1980s as a response for the request for the purpose of communication medium by Daimler- Benz [1]. CAN protocol is a message-based protocol, which is multi-master, broadcast serial bus developed for automotive applications to interconnect ECUs. CAN is based on broadcast communication which is based on the message- oriented transmission protocol. It is twisted pair wire which consists of CAN high and CAN low [10].

It supports half- duplex communication and it also offers high speed communication upto 1 Mbits/sec [7] approximately for 25m length of wire. But practically it can provide upto 500 kbps [7]. Theoretically, it can link upto 2032 nodes, but due to hardware limitations it can link upto 110 nodes. According to ISO 11898-1 [8], CAN architecture represents only two layers of OSI model, i.e., Physical layer [9] and Data Link Layer. If the CAN message ID is lower, then the priority will be higher [3]. CAN has two identifiers, one is standard identifier and the other one is extended identifier.

LIN is a Local Interconnect Network, which consists of single master with multiple slave nodes. It is a Universal Asynchronous Receiver Transmitter (UART) [9]. It works as a sub-bus in most of the CAN bus applications. It offers speed upto 20 kbits/sec [7]. It is an architecture developed for automotive sensors and actuator networking applications[9]. LIN is also known as multi-point bus, where single point is shared by multiple devices. It is low cost[11], single wired easily implemented communication bus in automobiles. Gateways are the one which exchanges the messages or signals between CAN and LIN buses[11]. CAN and LIN conformance testing is the one where the standards have been tested according to the ISO specifications. Conformance testing helps the one to test the standard requirements specified in ISO.

II. LITERATURE SURVEY

A. *B.V.P. Prasad, Jing-Jou Tang, Liang-Chi Dai, Ying-Chao Chen, "Conformance Test of Automotive CAN BUS Transceiver: Empirical Research of Industry Case", IEEE (2020)*

In this paper, Controller area network (CAN) BUSes are used to achieve Simple, practical and reliable functions enable communication between vehicle electronic control units. It is also widely used in many fields such as industrial automation, marine, medical and other fields.

The reliability and safety of CAN BUS are the core of autonomous vehicle development. The CAN Bus system test specification was developed by the semiconductor manufacturer based on the vehicle manufacturer's requirement. Additional test cases are defined in ISO 11898-2:2016 and ISO 16845-2. These two standards are designed to evaluate the performance of CAN physical layer and data link layer signals. Conformance testing verifies that CAN transceivers interact correctly in complex CAN networks using devices from different vendors. These tests are run in a reference environment using predefined settings to ensure the highest level of repeatability and comparability of test results.

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B. Keshav Bimbraw, "Autonomous cars: Past, present and future a review of the developments in the last century, the present scenario and the expected future of autonomous vehicle technology", IEEE (2019)

The above paper can help you understand past, present and future autonomous vehicle technology trends. Technology has the drastic change in autonomous vehicle. From the 1920s, when the first radio- controlled cars were developed. Then in the following decades came self- driving electric cars powered by integrated circuits on the road. By the 1960s, autonomous vehicles with electronic control systems already existed. Around 1980s, vision-guided autonomous vehicles were huge step forward in technology and to this day similar or established forms of vision and radio-guided technology have been modification is still used. Various semi-autonomous functions introduced in modern vehicles such as lane keeping, automatic braking and adaptive cruise control. The future of autonomous vehicles should be an ambitious era of safe and comfortable transportation.

C. Priyanka A. Wagh, Rohit R. Pawar, Dr. S. L. Nalbalwar, "A Review on Automotive Safety System Using CAN Protocol", IJCESR(2017)

Driver and passengers safety is the main concerns today's vehicle. Automotive electronics are expanding rapidly as driver assistance increases, safety and infotainment devices become standard in new vehicles. A major hurdle in the current system was cost, along with money. A temperature sensor is used to signal a higher engine temperature. For gas leak alarms, gas sensors and exhaust gas monitoring are used. Ambient light sensors are used for glare effects collisions that can be caused by oncoming vehicle headlights while driving at night. Current sensors are used for short circuit in automotive vehicles. Fuel level sensors are used to monitor the fuel level. The proposed system has two master and slave modules communicating via CAN bus. The First 3 sensors mentioned above are connected to the master and remaining 4 sensors are connected to the slaves. The proposed system is cost-effective in terms of security system, reliability and equipment size.

D. Gururaj K S, Namratha Sindhu P R, "Analysis of Can, LIN Protocol and Wireless Body Control Module", IJERT(2017)

Body Control Modules(BCMs) are an important part of the automotive industry that considers the functionality of the entire vehicle. All functions in the body control module are controlled by a microcontroller-based system called the body control module(ECU). This study is based on the analysis of CAN, LIN and wireless BCM communication and which wireless approach is the most suitable for wireless BCM in terms of parameters such as achievement of wireless body control module using various wireless protocols and signal loss, interference and path loss.

E. Ashish Srivastava, Debashis Adhikari, "CAN-LIN Bridge for Driver Assistance and Passenger Comfort an Optimized Resource Approach", IEEE (2017)

The expansion of automation has paved the way for interconnecting the subsystems using CAN and LIN communication protocols. The CAN protocol provides serial communication that can effectively support real-time distributed operations with a high-level of security. The LIN protocol is primarily designed for low-cost, low data-rate communication. The main contribution of this article is that a CAN-LIN bridge is proposed to connect the two chips of the above protocol. From there, the MCP2021 and MCP2551 are used to provide comfort to the occupants(the backrest reclines fore and aft and the seat moves back and forth) and assist the driver(wiper actuation).

III. COMPARISON TABLE

TABLE 3.1

Author and Year	Title	Remarks
B.V.P. Prasad, Jing-Jou Tang, Liang-Chi Dai, Ying-Chao Chen (2020)	Conformance Test of Automotive CAN BUS Transceiver: Empirical Research of Industry Case	This document describes the behavior of a CAN transceiver during testing and compares it to the datasheet or the predicted performance provided in the datasheet. In this article, we study and apply CAN ISO-11898-2/5 and ISO- 16845-2 compliant standards to test the performance of CAN transceivers.

Keshav Bimbraw (2019)	Autonomous cars: Past, present and future a review of the developments in the last century, the present scenario and the expected future of autonomous vehicle technology.	This article outlines the development timeline for autonomous vehicles. The development of self-driving vans, led by Mercedes- Benz has revolutionized the approach used in autonomous vehicles. This article is about the future scale of autonomous vehicles. It also states that official forecasts indicate that by 2035 most cars will be fully autonomous.
Priyanka A. Wagh, Rohit R. Pawar, Dr. S. L. Nalbalwar (2017)	A Review on Automotive Safety System Using CAN Protocol	This article explains how to avoid problems when driving at night because most accidents happen at night rather than during the day. It is mentioned that about 120 CAN parameters are controlled via CAN. With the help of sensors, it is also possible to make cars autonomous, like Google cars.
Gururaj K S, Namratha Sindhu P R (2017)	Analysis of Can, LIN Protocol and Wireless Body Control Module	The proposed system provides efficient wireless communication and reduces dependence without affecting essential vehicle functions. In order to implement these technologies, it is necessary to analyze various wireless technologies. ZigBee wireless sensors are suitable for short-distance communication and are evaluated for high performance with low-power consumption, which is a major-advantage in the automotive sector.
Ashish Srivastava, Debashis Adhikari (2017)	CAN-LIN Bridge for Driver Assistance and Passenger Comfort An Optimized Resource Approach	The CAN-LIN Bridge was intended for low-end vehicles as it can provide features that are available on high-end vehicles. High-quality applications for users can also be expected to be implemented at low-cost.

IV. CONCLUSION

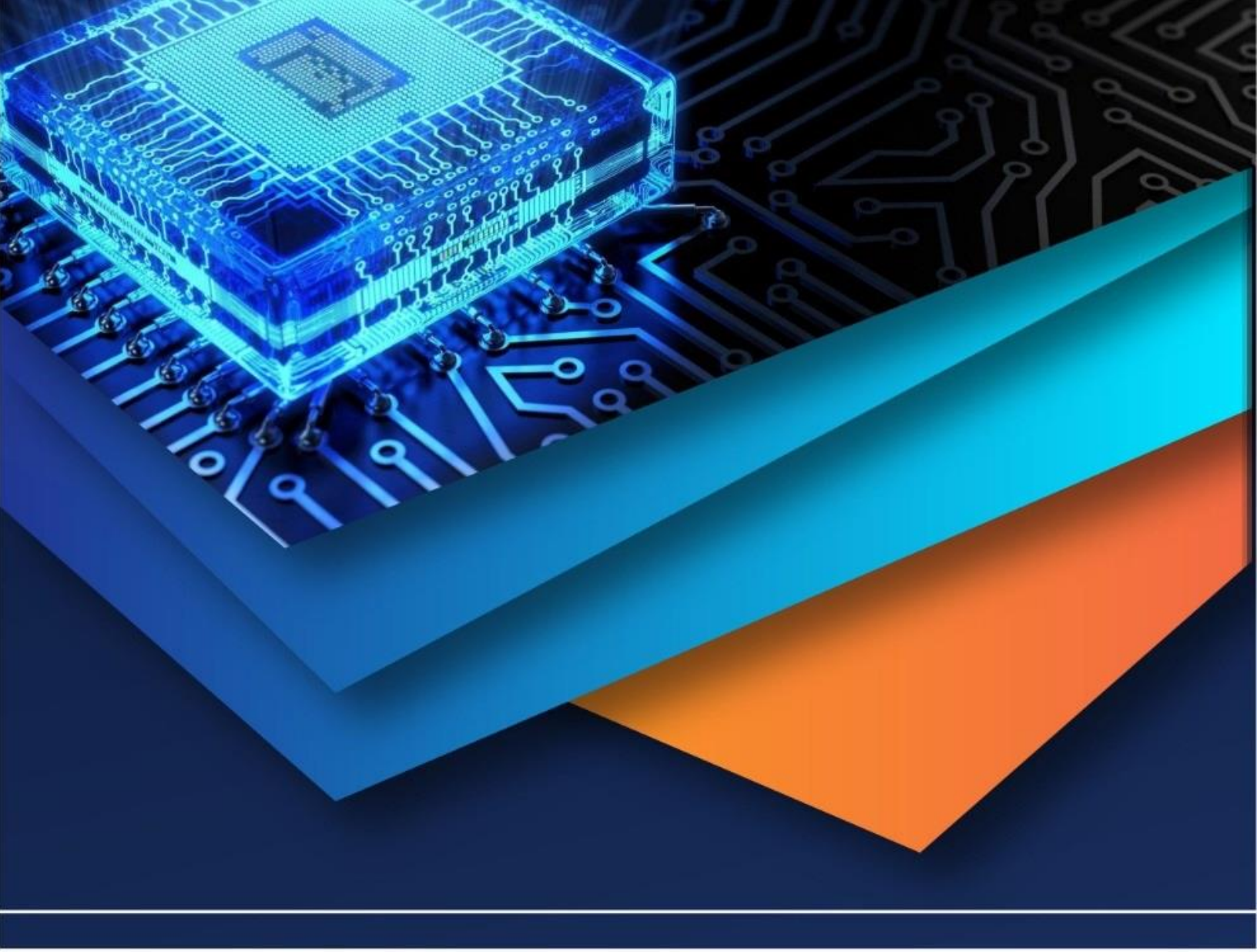
CAN and LIN protocols plays a major role in autonomous cars. CAN protocol acts as a main bus for the LIN. LIN protocol provides upto 20 kbps data rate which consumes low cost. LIN protocol has single master with multiple slave node. Whereas CAN protocol is the one which provides speed upto 1Mbps with serial communication. CAN and LIN protocols communicate with each other through gateways, where the data can be exchanged between them. Conformance testing helps to find the product or a service that meets the requirement of the specifications of the above mentioned CAN and LIN protocols.

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