# CONTROLLER AREA NETWORK FOR WIRE HARNESS IN AUTOMOTIVE APPLICATION

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***Abstract***

*Due to increase in expectations of the user's about Safety, Luxury and infotainment, resulting in increase in number of Electronic Control Units. As number of ECUs is increased, the number of wires for carrying signals from one unit to another unit in an automotive is increased rapidly. This result in wiring mesh known as wiring harness is increased. This creates lots of issues in an automotives.*

*This paper focuses on the issues identified and reported due to wire harness and one of the possible and feasible solution i.e. implementation of CAN in automotive sector.*

***Keywords:*** *CAN, Wire Harness, Automotive*

## 1. Introduction

Increase in expectations from end users as well as tremendous competitions among manufacturers of auto industries resulted in to increase in use of numbers of ECUs. Due to rapid development in semiconductor industries, the cost of electronic components is getting decreased exponentially with increase in computational powers and reliability.

There are lots of problems reported after survey and practical experience like Wrong Wire Groundwork, Inappropriate Harness Layout, Inappropriate Labeling, Defective Crimping Process, Defective Soldering Process, Misplaced or wrong H/W and Inappropriate Tying of the wires etc reported [5] by Association Connecting Electronics Industries.

One of the major drawbacks is increase in overall weight of the vehicle more than 15 Kg which is a deciding factor for calculating the overall performance of vehicle. To overcome these issues due to wiring harness , in 1980's the Bosch has released one standard known as Controller Area Network protocol to minimize the issues. CAN is a two wire message oriented protocol. Today lots of research is going on effective implementation of CAN, not only in automotive sector but wherever the wiring harness is becoming the major issues in degrading the performance of the automotives.

## 2. Literature Survey

### 2.1 Increases in ECUs – Statistics

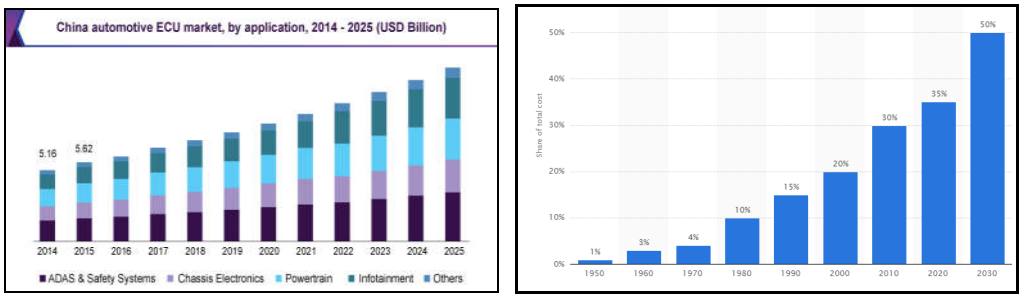


**Figure 1:** Future Statistics Increase in Number of ECUS & Market Share

Above statistics clearly shows the future for automotive components. There is an exponential growth not only in international market but it gradually increases in the developing country like India [1][3][4].

### 2.2 Wiring Harness & Problems Identified & Reported

Like the nervous system in human body, the wires are grouped with the connectors and terminals inside an automotives are known as wiring mesh or wiring harness [6][9]. It plays a vital role in interconnecting different components to carry information from one unit to another. Following are the problems identified and reported by association connecting electronics engineers [5].

**Problem – 1: Wrong Wire Groundwork**

The verification is one of the most important factors to ensure the correct wire and strip length. If the tool is not used properly , it may leads towards the damaging og insulation and conductor.

**Problem – 2 Inappropriate Harness Layouts**

The wire may be routed to the wrong location if the attention is not paid closely while assembling. Also in case of missing wires, results in to a big problem.

**Problem – 3 Inappropriate Labeling**

In the design document there is information given in the form of labels to and from the wires are expected to be connected. Unfortunately one may face problem when the harness is connected to the chassis. It is due to the mistake in Wire ID labels or the correct labeled wires are connected to wrong labels.

**Problem – 4 Defective Crimping Processes**

In this type of problems are reported like formation of open or short circuits, marginally crimping gives output for short time period and later it gets fails. Also because of very small crimping height results in fracturing of metal reducing the capabilities of carrying the currents.

**Problem – 5 Defective Soldering**

The incorrect temperature used while soldering as well as use of proper soldering process with proper use of tip size of soldering gun doesn't give long lasting results.

**Problem – 6: Misplaced or wrong H/W**

This is one of the common problems while trying to meet the deadlines given. In this type of problem the incorrect hardware may be attached to the wire. Also even a small mistake of use of incorrect screws creates big problem.

**Problem – 7: Inappropriate Tying of the wires**

The tying of the wires should not be too loose as well as too tight. In both the cases it creates the problems like damaging of the wires and unable to hold the bundle of wires respectively.

## 2.3 Centralized (Existing) Vs CAN based Approach

Figure 2 depicts two approaches for implementation of connectivity of ECU's in a typical vehicle in modern Car. In centralized approach there is requirement of point to pint connectivity resulting in increase in wire harnessing as well as overall weight of an automotive.

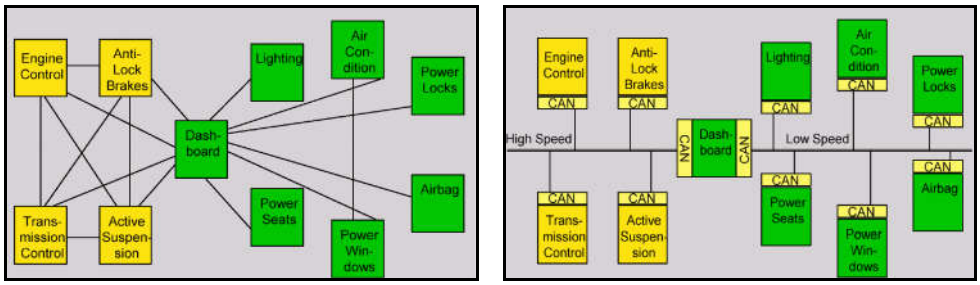


**Figure 2:** Centralized and CAN Based Approach for ECU Communication

## 2.4 CAN – Statistics – Graph & Features

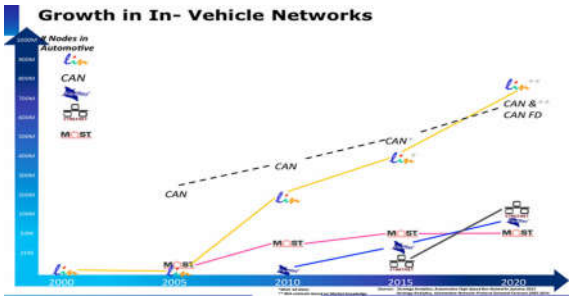


**Figure 3:** Exponential growth in in-vehicle network protocols is forecast as bandwidth demands have increased (Source: Strategic Analytics.) [4].

**2.5 CAN – Features at a Glance [2][10].**

- It supports the communication speed up to 1 Mb/s for the bus length of 40 M.
- Non-destructive collision detection by bitwise arbitration.
- Any message has a specific priority on the bus.
- Messages can be sent point to point or be broad- or multi-casted.
- Remote messages supported. A Functional Unit can always be prepared to
- Low-cost CAN Controllers are available by Intel, Motorola, Philips, Siemens etc.

- Information over CAN bus doesn't affected by Electrical & Magnetic Interference.

## 3. System implementation

### 3.1 CAN – Prototype (Block Dig.)

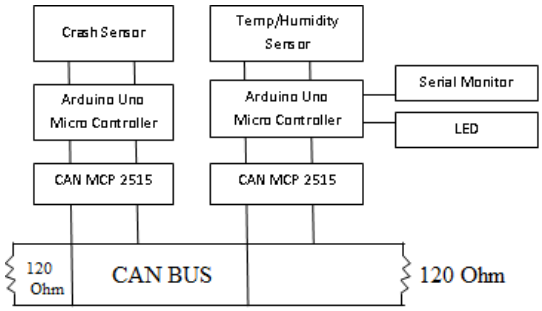


**Figure 4:** Block Diagram of CAN Communication

### 3.2 CAN Bus Signal Representation & Frame Format

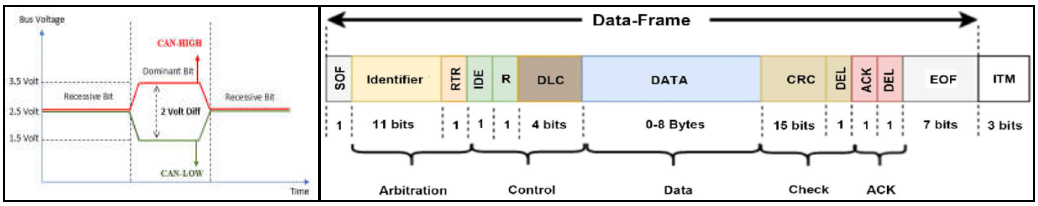


**Figure – 5:** CAN Bus Signal Representation & Frame Format [7] [8].

Figure – 5 shows the signal representation of CAN bus. The signals are represented by calculating the difference in voltage levels. The logic 1 is known as Recessive Bit and the logic Zero is known as Dominant bit. Also in CAN frame format it shows different fields like Arbitration, Control Data, Check and acknowledgement.

### 3.3 Sample Output on Serial Plotter

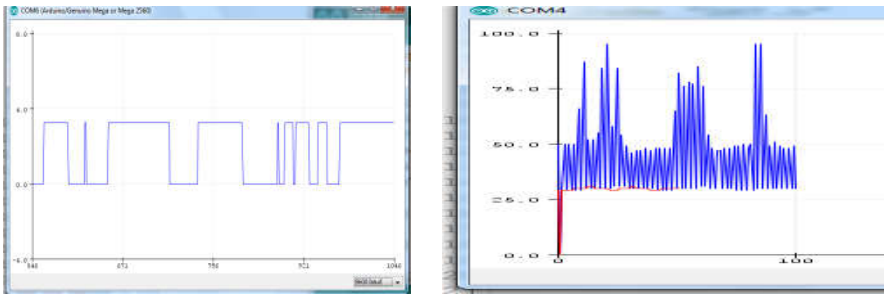


**Figure 6:** Outputs Observed on Serial Plotter Crash Sensor, Temp. & Humidity Sensor.

### 3.4 CAN – Other Upcoming Application Areas

- Healthcare
- Science
- Construction
- Energy generation
- Entertainment
- Manufacturing
- Communication
- Retail
- Transportation
- Agriculture

## 4. Acknowledgement

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## 5. Conclusion & Future Scope

This paper focuses on the issues identified and reported due to wire harness and one of the possible and, feasible solution i.e. implementation of CAN in automotive sector.
To achieve more reliability in mission critical applications, there is great scope to have implementation of CAN using redundancy at Controller as well as sensor levels.

## 6. References


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