



# **Bosch's CAN bus**

## **Investigation of the standard**

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# INTRODUCTION AND BASIC CONCEPTS

- ▶ Controller Area Network [1]
- ▶ Serial communications protocol/bus system
- ▶ Supports distributed realtime control with a very high level of security

# PURPOSE AND CONTEXT

- ▶ Created by BOSCH
- ▶ Used automotive industry
- ▶ Automotive electronics, engine control units, sensors, anti-skid-systems
- ▶ High speed networks to low cost multiplex wiring

# RELATED STANDARDS

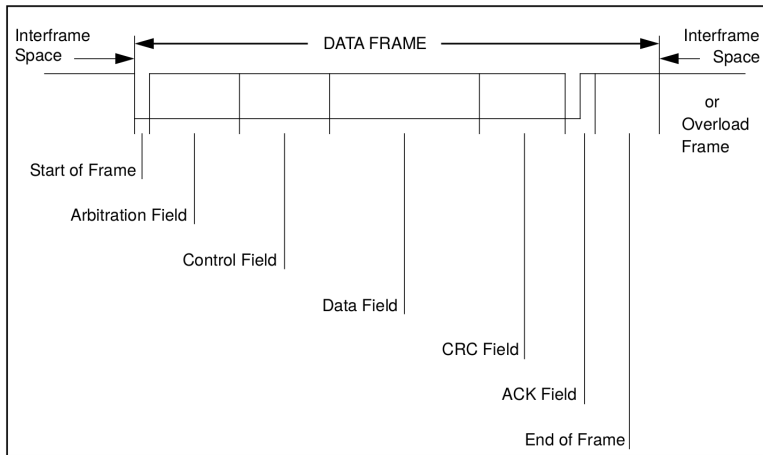
- ▶ standardized after ISO 11898
- ▶ ISO 11898-2 (Hightspeed-CAN) - related
- ▶ ISO 11898-3 (Lowspeed-CAN)- related
- ▶ Not compatible with each other

# MESSAGE TRANSFER AND VALIDATION – 1

## Overview:

- ▶ Information is sent in fixed format messages of different but limited lengths
- ▶ When free, any connected unit may send messages over the bus
- ▶ The content of the message is named by an identifier

## MESSAGE TRANSFER AND VALIDATION – 2



## MESSAGE TRANSFER AND VALIDATION – 3

- ▶ A unit sending a message is the “transmitter” of that message
- ▶ It stays transmitter, until the bus is idle or it loses arbitration
- ▶ A unit is called “receiver” of a message, if it is not the transmitter and the bus is not idle

# CODING AND ERROR HANDLING – 1

## Overview:

- ▶ Bit stuffing → control mechanism
- ▶ Distortions etc. → error handling to achieve error tolerance
- ▶ 5 different error types (Bit, Stuff, CRC, Form, ACK)



## CODING AND ERROR HANDLING – 2

- ▶ Message passing mechanism, no additional structure needed
- ▶ Errors broadcasted when detected
- ▶ Semantics important for correct transmission
- ▶ Drivers: reliability, error limitation
- ▶ Problem: new error types?

# FAULT CONFINEMENT

- ▶ Unit can have 3 states and 2 counters
- ▶ Strength: Enables extensibility
- ▶ Drivers: Separation of concern, reliability, error limitation
- ▶ Problem: More Unit means more errors?

# BIT TIMING REQUIREMENTS

- ▶ List of definitions and rules
- ▶ Strength: short, but includes everything important
- ▶ Weaknesses: almost text only, hard to read (structure), like a glossary
- ▶ Improvable by usage of more pictures and examples

# CAN IMPROVEMENTS – 1

**Aim:** Increase Oscillator Tolerance

**Modifications:**

- ▶ Delay START OF FRAME (SOF) by fully sample INTERMISSION
- ▶ Insert (not necessary) OVERLOAD FRAME
- ▶ Synchronise on recessive to dominant edges

## CAN IMPROVEMENTS – 2

Still valid:

- ▶ Hard Sync on SOF
- ▶ No SOF until three recessive Bits on INTERMISSION have been read

What was achieved?

- ▶ Use of ceramic oscillators instead of quartz oscillators  
→ PRICE!
- ▶ But...all nodes need to work with the enhanced protocol  
AND only if the most demanding node works with high tolerance

# CONCLUSION

# REFERENCES



Robert Bosch GmbH.  
CAN Specification.

[http://www.bosch-semiconductors.de/media/ubk\\_semiconductors/pdf\\_1/canliteratur/can2spec.pdf](http://www.bosch-semiconductors.de/media/ubk_semiconductors/pdf_1/canliteratur/can2spec.pdf).

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