



CAN bus **(Controller Area Network)**

Part 1

ECE 2534



CAN bus

- **CAN bus is a standard for asynchronous, half-duplex, serial communication**
- **Originated for automotive applications**
- **History**
 - Developed by Bosch in the 1980s
 - Became an SAE standard in 1986
 - CAN 2.0 specification was released in 1991
 - Since 1996, every car and light truck sold in the US has a built-in debug connector that supports CAN
- **2-wire differential bus**
- **Bit rates up to 1 Mbit/s**
(known, fixed rate on any given system)



What is needed in an automobile?

- Deterministic (predictable) behavior, especially for communication latency
- Dependability
- Relatively high speed
- Adaptibility
 - variable network loading
 - network (re)configuration
- . . .



ECU = Electronic Control Unit

- Your car may contain dozens of ECUs
- These ECUs are microcontrollers taking care of many different things
 - ☐ engine control
 - ☐ antilock breaking system (ABS)
 - ☐ power steering
 - ☐ windows, doors, mirrors
 - ☐ cruise control
 - ☐ . . .
- These ECUs need to communicate with one another

CAN CLASS B

- 1 SAM/SRB Fahrer
- 2 SAM/SRB Beifahrer
- 3 SAM/SRB Heck 1
- 4 SAM/SRB Heck 2
- 5 Sitzsteuergerät Fahrer
- 6 Sitzsteuergerät Beifahrer
- 7 Sitzsteuergerät hinten links
- 8 Sitzsteuergerät hinten rechts
- 9 Türsteuergerät vorne Fahrerseite
- 10 Türsteuergerät vorne Beifahrerseite
- 11 Türsteuergerät hinten Fahrerseite
- 12 Türsteuergerät hinten Beifahrerseite
- 13 Steuergerät Trennwand
- 14 Dachbedieneinheit
- 15 Dachknoten Mitte (DKM)
- 16 Vorderes-Becken-Feld (VBF)
- 17 Hinteres-Becken-Feld (HBF)
- 18 Elektronisches Zündschloss (EZS)
- 19 Kombiinstrument
- 20 Mantelrohrmodul
- 21 Frontklimatisierung
- 22 Fondklimatisierung
- 23 Audiotgateway

- 24 Parktronicssystem (PTS)
- 25 Radendruckkontrolle (RDK)
- 26 Pneumatische Steuereinheit (PSE)
- 27 Heckdeckelfernschliessung/-öffnung
- 28 Zentrales Gateway
- 29 Airbag-SG (Armada)
- 30 Multifunktionssteuergerät (MSS)
- 31 Bordnetz Steuergerät
- 32 Wandler Lenkschleifung
- 33 Standheizung
- 34 Türzuziehung hinten Fahrerseite
- 35 Türzuziehung hinten Beifahrerseite

CAN CLASS C

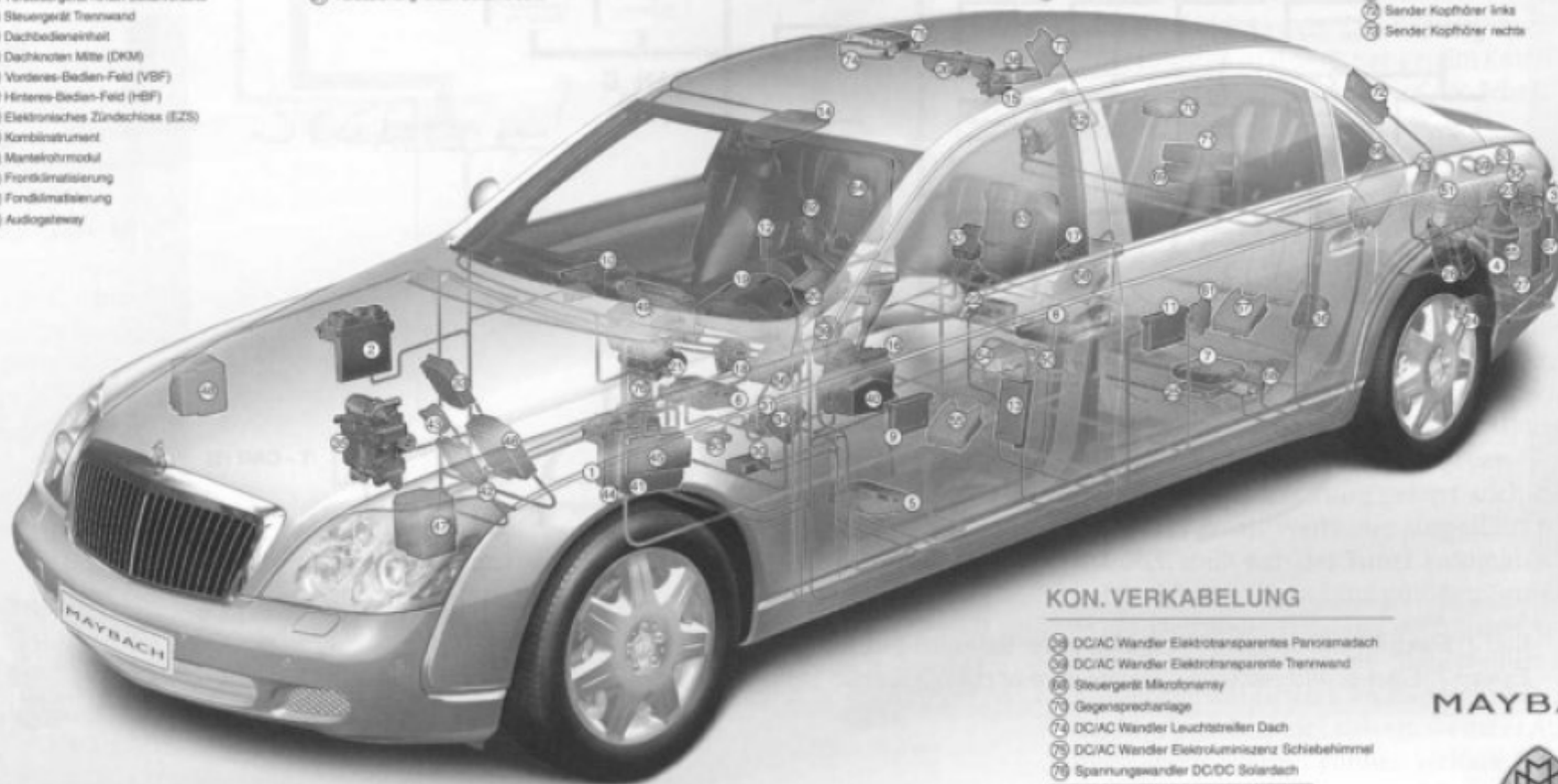
- 18 Elektronisches Zündschloss (EZS)
- 19 Kombiinstrument
- 20 Mantelrohrmodul
- 21 Zentrales Gateway
- 22 Elektronisches Wählhebelmodul
- 23 Luftfederung (SLF)
- 24 Dabtronic (DTR)
- 25 Leuchtwertenregulierung
- 26 Motorelektronik (ME)
- 27 Sensotronic Brake System (FSG)
- 28 Elektronische-Getriebe-Steuerung

MOST-BUS

- 24 Audiotgateway
- 43 Headunit
- 50 Steuergerät Sprachbedienung
- 51 TV-Tuner MOST
- 52 Soundverstärker
- 53 Navigationsrechner
- 54 Kommunikationsplattform (CP1)

PRIVATE-BUS

- 5 Sitzsteuergerät Fahrer
- 6 Sitzsteuergerät Beifahrer
- 7 Sitzsteuergerät hinten links
- 8 Sitzsteuergerät hinten rechts
- 9 TV-Tuner CAN
- 26 Dachinstrument
- 49 Sensotronic Brake System (FSG)
- 49 Sensotronic Brake System (ASG1)
- 49 Sensotronic Brake System (ASG 2)
- 56 Multikonturlehne vorne links
- 56 Multikonturlehne vorne rechts
- 57 Multikonturlehne hinten links
- 58 Multikonturlehne hinten rechts
- 59 Keyless Go Headmodul
- 60 Keyless Go Innenraummodul
- 61 Keyless Go Tür hinten links
- 62 Keyless Go Tür hinten rechts
- 63 Fondbildschirm links
- 64 Fondbildschirm rechts
- 65 Kommunikationsplattform Fond (CP2)
- 66 Surround Amplifier
- 67 Audio Video Controller
- 68 CD-Wechsler
- 70 DVD Spieler
- 72 Sender Kopfhörer links
- 73 Sender Kopfhörer rechts



KON. VERKABELUNG

- 69 DC/AC Wandler Elektrottransparentes Panoramadach
- 69 DC/AC Wandler Elektrottransparente Trennwand
- 69 Steuergerät Mikrofonarray
- 70 Gegensprechanlage
- 74 DC/AC Wandler Leuchtwerten Dach
- 75 DC/AC Wandler Elektrolumineszenz Schiebehimmel
- 76 Spannungswandler DC/DC Solardach

Σ aller Steuergeräte: 76

MAYBACH





CAN bus fundamentals (p.1)

- Communications are driven by **events**
 - Each message gets an identifier (type) and is broadcast on the network
 - All nodes (microcontrollers) connected on the network can receive this message and decide what to do with it
- Multiple access
 - Any node can communicate when it has something to send
 - There is a strict priority in the messages, and higher priority messages will always be transmitted first
 - When there are collisions (multiple nodes trying to transmit at the same time), only the most important message will be transmitted



CAN bus fundamentals (p. 2)

■ Fault detection and confinement

- The protocol supports reporting of errors, and even has provisions to deactivate nodes that appear faulty
- “Confinement”:
keep faults local; don't let them take the bus down


■ 2 types of data transfer

- **Data transfers**, originating from an event
- **Remote request transfers**, when a node is asking for a message of a given type



How to share the bus?

- No node addressing
 - Every message has an identifier that reflects a given priority of the message
 - The message is captured by all nodes on the CAN network.
 - The lower the message identifier number, the higher its priority
- CSMA/CD protocol
(Carrier Sense Multiple Access with Collision Detection)

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- The 2-wire bus can have one of 2 possible values:
 - d – “dominant”
 - r – “recessive”
 - If one transmitter sends d and another sends r at the same time, the bus will have a value of d



Summary

- The CAN protocol is message-oriented, not address-based
- The CAN protocol was optimized for systems that need to transmit/receive relatively small amounts of data, but with high reliability and predictability
- Every node has an equal chance to gain access to the bus