



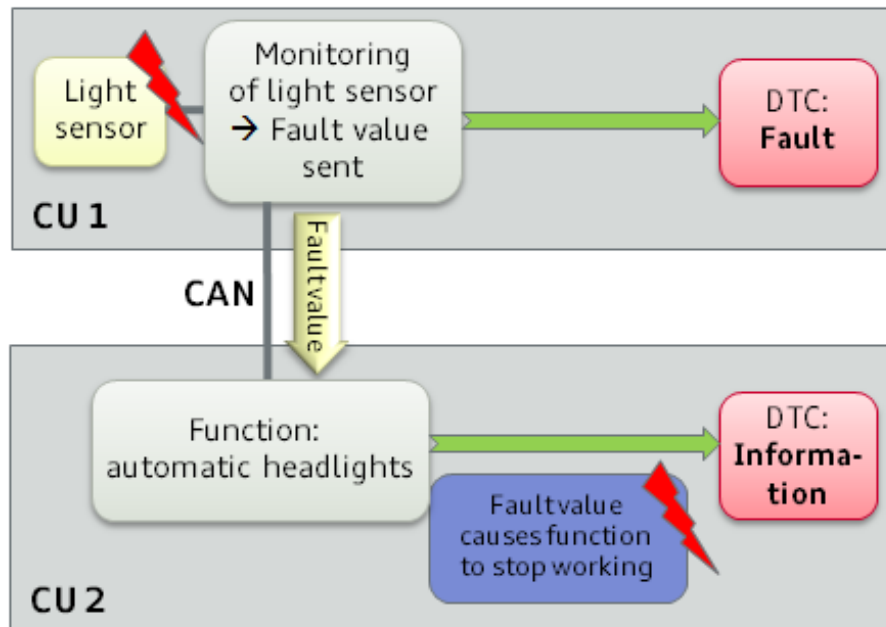
Bus monitoring and DTC diagnosis

Information

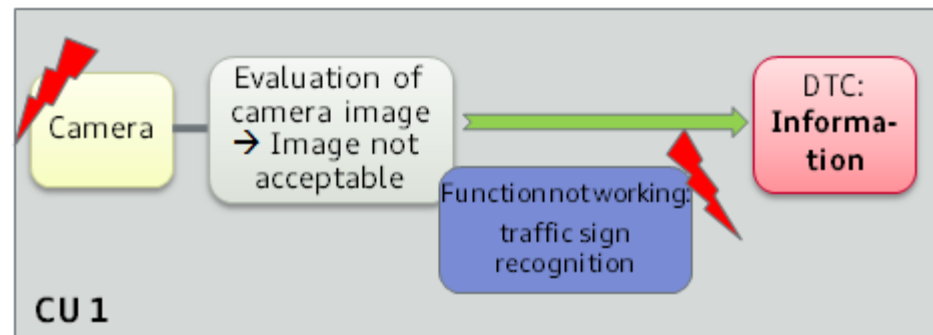
- ▶ Concept: fault memory entries used as information
- ▶ Information is stored in a control unit (CU) whenever a fault outside of the CU means that a function can no longer be performed by the customer.

=> This process prevents the CU from being repaired/replaced!

- ▶ Example 1: Light sensor failure



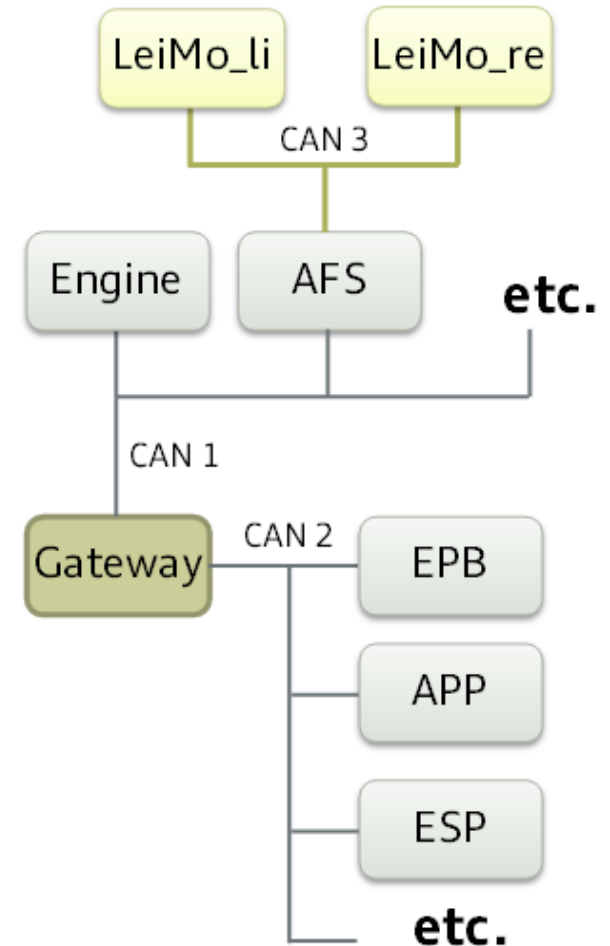
- Example 2: Camera becomes dirty



Bus monitoring

Overview

- ▶ Each bus segment has a bus master
→ central role for bus diagnosis
 - ▶ Installation monitoring and communication monitoring for the main bus segments (powertrain CAN bus, convenience CAN bus, FlexRay etc.) via the Gateway
 - ▶ Monitoring of sub-busses via the corresponding sub-bus master (e.g. BCM1 for rain-light sensor and headlight switch)
- ▶ Bus master enables message routing (transferring a message from one bus segment to another)
- ▶ Depending on the fault scenario, either **faults** (priority 4) or **information** (priority 6) will be recorded in the control unit fault memories



Main bus segments: CAN 1 and CAN 2
Sub-bus segment: CAN3

Electrical faults on the data bus (e.g. CAN)

Single-wire faults

- ▶ Short circuit CAN_Low to ground or CAN_High to plus
- ▶ Only monitored by the bus master
- ▶ Fault output (only in bus master):
 - ▶ Data bus XY in single-wire operation, priority 4 (fault)
(e.g. *U001800 Convenience CAN bus in single-wire operation*)

Defective data bus faults

- ▶ Control unit unable to send any messages (bus in "off" status)
- ▶ Monitored by all CUs; once a fault is recognized, no more messages are sent
→ This process prevents a faulty CU from disrupting other lines of communication
- ▶ Fault output (bus master and emission-related control units):
 - ▶ Data bus XY defective, priority 2–4 (fault)
(e.g. *U001000 Convenience CAN bus defective*)
- ▶ Fault output (other control units)
 - ▶ U120000 Data bus defective, priority 6 (information)
 - ▶ Data bus XY defective, priority 6 (information) if the CU has several bus connections

Fault monitoring at message level

Message timeout

- ▶ Monitoring of at least one pre-defined message from a control unit
- ▶ Monitoring via bus master (for each bus segment connected to the CU)
- ▶ One control unit monitors all other control units from which at least one message is received

- ▶ Fault output (bus master and emission-related control units):
 - ▶ [CU] no signal/communication, priority 2–6
(e.g. *U013000* No communication to control unit for active steering)
- ▶ Fault output (other control units)
 - ▶ *U112100* Data bus did not receive message, priority 6 (information)

Fault monitoring at message level

Range value monitoring

- ▶ Messages are monitored to ensure they are in the correct format, for example a range value fault (e.g. specified value[0–9], received value: 12)
- ▶ Monitoring is only performed for customer relevant functions
- ▶ Fault output (emission-related control units):
 - ▶ CU XY implausible signal, priority 2–4 (fault)
(e.g. U040200 CU for gearbox sending an implausible signal)
- ▶ Fault output (other control units)
 - ▶ U112200 Data bus receives implausible message, priority 4 (fault)
- ▶ These faults are normally due to incorrect/incongruous control unit data entry or incorrect installation
 - ▶ Check by performing an SVM Spec/Actual comparison or by creating a request to the Audi Technical Assistance Center (TAC)
 - * Spec/actual result may show OK if the reference in the database is incorrect, once the reference is corrected the fault does not re-occur.

Fault monitoring at message level

Fault values

- ▶ If a control unit recognizes that it cannot provide a value in a message due to a fault, a fault value (e.g. 0xFF) is sent

- ▶ Fault value for the transmitting CU
 - ▶ Sensor xy defective, priority 4 (fault)
- ▶ Fault value for the receiver (only for customer relevant functions):
 - ▶ U112300 Data bus received fault value, priority 6 (information)
- ▶ Fault value for the receiver (emission-related control units)
 - ▶ CU XY implausible signal, priority 2–6 (fault)
(e.g. U040200 CU for gearbox sending an implausible signal)

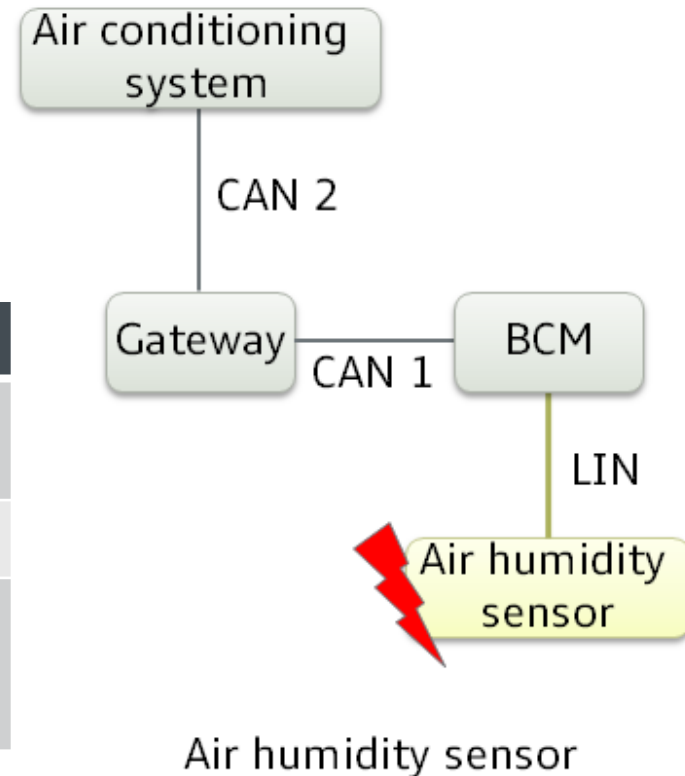
- ▶ The entry *Data bus received fault value* only indicates that the actual fault is to be found in another control unit.

Example 1

Sensor signal failure (LIN message)

- ▶ Air humidity sensor does not have its own fault memory
→ Monitored by BCM
- ▶ Air humidity sensor message routed to CAN 1 and CAN 2
- ▶ Air humidity sensor message used by the air conditioning system
- ▶ If the **sensor fails**, the following fault memory entries are stored:

Control unit	DTC	Priority
BCM	No signal/communication to air humidity sensor	4 (fault)
Gateway	- No entry -	-
Air conditioning system	Data bus did not receive message	6 (information)



Example 2

Control unit communication failure

- ▶ ESP has a faulty bus connection → no messages received
- ▶ Installation monitoring in Gateway recognizes a timeout in the ESP control unit
- ▶ All control units using ESP signals (e.g. speed signals) record faults or information (for customer relevant functions)

Control unit	DTC	Priority
Gateway	No communication with ESP	4 (fault)
AFS	Data bus did not receive message	6 (information)
Engine (emission-related)	No communication with CU for ABS brake	2 (OBD fault)
etc.	etc.	etc.

