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## THEORY (20 HOURS)



[1] • = content or idea to be explained to students.

- Error frame
- Overload frame

2.3.- DATA EXCHANGE – 60 MINS

2.3.1.- MESSAGES AND SIGNALS – 30 MINS

- How a signal fits into a message. How information fits into a signal. Example.

2.3.2.- K-MATRIX – 30 MINS

- 211 K-matrix explanation: type of signals, ECUs…
- Different K-matrix for every CAN (CAN B, CAN D, CAN C)
- Every vehicle model may have different K-Matrix which may change also from release to release.

2.4.- NETWORK MANAGEMENT – 20 MINS

- Ring between CAN nodes, addresses and network management messages and signals.

2.5.- TRANSPORT PROTOCOL – 30 MINS

- Description and examples (W_REG, AW_REG, DEL…).
- Transport protocol disassembler

2.6.- CAN BEYOND THE AUTOMOTIVE INDUSTRY – 40 MINS

- CAN protocols: CANopen, CAnaerospace
- Examples: spacecraft, locomotive.

3.- CANOE: CAN OPEN ENVIRONMENT

3.1.- HARDWARE – 10 MINS

- Cables, transceivers, license (CANcase, CANcard)

3.2.- SNIFFING – 160 MINS

3.2.1.- CREATE A NEW PROJECT – 20 MINS

- DDBB, channels, baud rate (low&high).

3.2.2.- CANOE WINDOWS – 140 MINS

- Explanation about buttons, menus and options for different CANoe windows.

3.3.- CREATE A SIMULATION: DESIGN AND DEVELOPMENT – 120 MINS

3.3.1.- CANDB EDITOR – 30 MINS

- Define Network nodes, messages and signals in order to create a DB.

3.3.2.- PROGRAMMING: CAPL – 60 MINS

- CAPL Nodes management
- CAPL browser
- Messages
- Events management
- DLL: library of routines

3.3.3.- MODELLING– 30 MINS

- Environment Variables
- Panel Editor

3.4.- FUNCTION BLOCKS – 60 MINS

- How to define them and behaviour.

3.4.1.- GENERATOR BLOCK – 20 MINS

3.4.2.- INTERACTIVE GENERATOR BLOCK. – 20 MINS

3.4.3.- REPLAY BLOCK – 20 MINS

4.- OPTICAL RINGS AND TOOLS

4.1.- D2B OPTOLYZER – 30 MINS

- Equipment needed
- Optolyzer: Mode, Setup, Recorder and Viewer

4.2.- MOST OPTOLYZER – 30 MINS

- Equipment required
- Optolyzer: initialization, configuration, viewer, recorder, filters and masks

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**PRACTICE (40 HOURS) –** Average of 5h per practice

**0. Physical layer on the CAN bus**
Analyze CAN frames with the help of an oscilloscope, checking issues such as voltages and bit periods in different CAN buses, and the way in which bit stuffing works.

Bench: BR203 Buses: CAN B, CAND Devices: CGW, TeleAid

**1. CAN analysis: IGN signals, TeleAid Info-Call and Volume control**
Trace CAN messages with the CANoe tool analyzing the traces and comparing them with the associated K-Matrix. Analyze the messages sent when the ignition of the car is turned on/off in order to understand how the vehicle bus wakes up. Identify the CAN messages transmitted when the volume control is changed or when the hang button is pressed during a TeleAid service call.

Bench: BR211 Buses: CAN B Devices: EIS, HU, CP

**2. CAN analysis: Airbag signals**
Trace airbag CAN messages with CANoe tool in BR211. Analyze the messages sent by the airbag sensor when a crash happens simulating the crash by shaking the airbag sensor.

Bench: BR211 Buses: CAN B Devices: CP, Airbag sensor

**3. Real Car Trace**
Analyze a standard CAN trace previously measured in a vehicle at DCAG in order to identify the messages and signals that are exchanged in a real car. The different signals should be identified by analyzing manually the traces.

Bench: None Buses: CAN D Devices: None

**4. Wake up by trunk button**
Modify or create a CANoe project by adding an Interactive Generator Block. It should send the "trunk button pressed" signal in order to wake up the CP as a RDU scenario.

Benches: BR211 Buses: CAN B Devices: CP

**5. TeleAid MMI warnings (IC/HU). CAPL Programming**
Connect the CANoe tool to a Suitcase Tester. Program in CAPL (CANoe Access Programming Language) and modify an already programmed CAPL application by adding new panels or tracing event and displaying them in the different CANoe windows.

Benches: Text Box Buses: CAN D Devices: Test Box, LCT

**6. D2B Optical Bus Analyzer**
Trace the D2B bus with the Optolyzer tool to reproduce and analyze the System Start-Up and Initialization Procedure, the normal mode and the shutdown of the optical D2B ring.

Bench: BR220 Buses: D2B Devices: HU, CD-Changer, Sound amplifier, ECall2

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### 7. MOST Optical Bus analyzer. HU-Telephony MMI

Trace the MOST bus with the Optolyzer4MOST and analyze the system initialization and the communication between the HU and the telephone during different events.

Benches: BR203 Buses: MOST Devices: HU, Telephony

## MATERIAL

a) BENCH BR211 CP (E-CLASS)

This Bench includes

| | | | |
|---|---|---|---|
| Central Gateway | Instrument Cluster 211 | Speech Dialog System | Mobil Telephone and cradle |
| Airbag Sensor | Audio Gateway (basic) | Electric Ignition System | Head Unit Comand Becker |
| Communication Platform TeleAid | | | |

b) BENCH BR211 CP RETROFIT (E-CLASS)

This Bench includes

| | | | |
|---|---|---|---|
| Central Gateway | Instrument Cluster 211 | Speech Dialog System | Mobil Telephone and cradle |
| Airbag Sensor | Audio Gateway Sound | Electric Ignition System | Head Unit Comand Becker |
| Communication Platform TeleAid | | | |

c) BENCH BR220 ECALL-2 (S-CLASS)

This Bench includes

| | | | |
|---|---|---|---|
| Head Unit Comand Becker | Instrument Cluster | GPS Antenna | Audio Gateway |
| Airbag Sensor | CD Changer | ECall2 | |

d) BENCH BR203 LCT (C-CLASS)

This Bench includes

| | | | |
|---|---|---|---|
| Central Gateway | Instrument Cluster 203 | SDARS | Mobil Telephone and cradle |
| Airbag Sensor | Audio Gateway Sound | Electric Ignition System | Head Unit 203 |
| Universal Mobile Interface | | Low Cost TeleAid | |

e) TEXT BOX+ LCT + AIRBAG

f) CANOE AND CANCASEXL

g) D2B SOFTWARE AND ANALYZER

h) MOST SOFTWARE AND ANALYZER

## ADDITIONAL BIBLIOGRAPHY /ANNEXES

- *CANoe User Manual*
- *Programming With CAPL*
- *Transport Protocol Telegram and Warning Types*
- *D2B Optical Basic Protocols*
- *MOST Function Catalog*
- *MOST Specification*