THE NEXT LEVEL OF SOFTWARE DEVELOPMENT IN COMMERCIAL VEHICLES

MathWorks AUTOMOTIVE CONFERENCE EUROPE 2022

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AGENDA

1. Commercial vehicle business & requirements
2. EE development - current status
3. The next level of software development
4. Summary – key take ways
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COMMERCIAL VEHICLE BUSINESS – MORE A MACHINE LIKE A VEHICLE
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CURRENT STATUS – EE ARCHITECTURE (SOP 2020)
CURRENT STATUS - FUNCTIONAL ARCHITECTURE

Strategic layer:
- Highway assist
- Adaptive cruise control
- Turn assist

Management layer:
- Object fusion
- Shifting strategy
- Torque management

Operational layer:
- Perception
- Gear shifting
- Torque control

Physical layer:
- Engine
- E-machine
- Gearbox
- Axle
- eAxle
- Radar
- Camera
FUNCTIONAL DEVELOPMENT STRATEGY I

- **Function Library**
  - Cruise control (CC)
  - Adaptive cruise control (ACC)
  - Shifting strategy (ASS)
  - Master energy management (MEM)

- **Domain**
  - Endurance brake
  - Brake
  - Powertrain
  - Transmission
  - Body & Light
  - Body Builder
  - Driver Information
  - Cabin Comfort
  - Energy Management
  - Infotainment

- **Function**
  - Brake
  - ACC
  - ACC Stop&Go
  - Driver Assistance
  - Transmission
  - Infotainment

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FUNCTIONAL DEVELOPMENT STRATEGY II

CVM

Domain Controller
- Chassis
- Powertrain
- Body
- Display
- Driver Assistance

Management and strategic functions lifted up to the CVM

Sub-Networks

Many new functions only correlates existing information (signals)

→ easy to implement on the middleware
TOPOLOGY

CCP – MAN COMMON CLOUD PLATFORM

CVM – CENTRAL VEHICLE MANAGER

CM4
Connectivity module

Diag

CIO-Module
Cabin

EIO-Module
Extended

RIO-Module
Rear

DIO-Module
Door

Powertrain
(conventional & BEV)

Chassis

ADAS

Body/Light

Digital driver workplace

ADC1
Automation controller

Mirror display left

Mirror display right

Secondary display

Primary display

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SYSTEM ARCHITECTURE

CM4
Connectivity module

Diag

CIO-Module
Cabin

EIO-Module
Extended

RIO-Module
Rear

DIO-Module
Door

Shifting strategy

Powertrain management

Chassis control

Brake management

Body control

Display control / HMI

Powertrain (conventional & BEV)

Highway assist
Traffic jam assist
Turn assist
Front / side assist
Lane keeping
LDW
CC / ACC
Fusion

Body / Light

ADAS

Digital driver workplace

Mirror display left
Mirror display right
Secondary display
Primary display

ADC1
Automation controller

Chassis

Body

CC / ACC

Lightning

LDW

Diag

Highway assist

Reflection

Crease

Language

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TECHNOLOGY MAP

Network
- LIN
- CAN
- CAN-FD
- Ethernet

Connectivity
- 4G / 5G
- WLAN
- Bluetooth

Backend
AWS technology

Operating system
- Hypervisor/Partitioning
- Micro C OS (AUTOSAR compatible)
- QNX
- LINUX / POSIX

Standards
- MAN meta model (signal based & service oriented)
- AUTOSAR classic
- Adaptive AUTOSAR

Interfaces
- SAE J1939
- MAN Middleware – Mont Blanc

Safety & Security
- ISO 26262 up to ASIL D
- UNECE cyber security

AppFrame
- HTML/Jscript
- QT

Interfaces
- SAE J1939
- MAN Middleware – Mont Blanc
KEY-FUNCTIONALITY

- Content management – version / variant control
- “THE relation tool”
- Requirement management
- Function data management
- Source-code management
- Architecture management
- Change/Issue management
- Agile planning component (SAFe compliant)
- Test management
- Dataset management
- Digital twin

Middleware / Application server

Oracle data base
CURRENT STATUS - EE ORGANIZATION (SAFe BASED)

- Hardware
- SW conventional
- SW automation
- SW backend
- Test

Function architecture

System architecture

Hardware architecture

Flow area Y (e.g. digital services)

Train system X

Team function B

Team service Z (DevOps)

Team component A

Train vehicle function C

Solution table
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NEW CHALLENGE - DOING EVERYTHING PARALLEL

- ICE Truck
- Step
- Step
- Step

1. Digital services
2. Battery electrical vehicle
3. Fuel cell vehicle
4. ICE vehicle
5. Autonomous driving
INTEGRATION OF THE VEHICLE IN THE LOGISTIC ENVIRONMENT

Logistic & transport management system of the customer

Vehicle as a services

- Services for vehicle management & connected vehicles
- Market place

- API
  - Digital Twin
  - Data
  - Cloud & Database
  - Connectivity & Security

Vehicle as a platform

- Abstraction layer
- Base technology
- Vehicle platform

- Vehicle conventional
- Zero emission vehicle
- Automated vehicle
MOVING FUNCTIONALITY IN THE CLOUD & COMBINE WITH ADDITIONAL DATA
FUNCTION MEETS SERVICE – EFFICIENT CRUISE FOR BEV

CCP – MAN COMMON CLOUD PLATFORM
- Navigation routing
- Booking
- Payment
- Charging station
- Route optimization

CVM – CENTRAL VEHICLE MANAGER
- Control
- Battery conditioning
- Driving

Backend

Vehicle

Software driven vehicle
CURRENT DEVELOPMENT - SOFTWARE DRIVEN VEHICLE

Same software technology (language, API, middleware independent of the environment (vehicle / cloud)
CLASSIC SIGNAL BASED MODEL – TASK: PROCESSING DATA

Model

Function A

Signal:
Name: signal_1
Datatype: uint8

Signal:
Name: signal_2
Datatype: bool

Data structure

FCN:

Input

SIGNAL:
@Datatype: uint8

Output

SIGNAL:
@Datatype: bool
CLASSIC SIGNAL BASED MODEL – CORRESPONDING TOOLCHAIN

- MATLAB, Simulink
- TargetLink model
- MSRSW (MDX) (XML)
- Local Data Dictionary

Generic interface
SERVICE BASED MODEL – TASK: PROCESSING DATA

**Model**

- Process A
  - get_method
  - set_method

**Data structure**

- FCN:
  - Input
    - CHANNEL:
    - SERVICE:
      - SIGNAL:
        - Output
          - CHANNEL:
          - SERVICE:
            - SIGNAL:
              - DATATYPE: avi
              - DATATYPE: struct
SERVICE BASED MODEL – CORRESPONDING TOOLCHAIN

Generic interface

MATLAB, Simulink

ARXML

SW-C

Server

Client
SUMMARY

1. A centralized architecture has big advantages in all dimension (cost, quality & time to market)
2. New end to end features for the customer leads us to a mix of vehicle & cloud oriented functions & services
3. This complexity leads to new development method & tools
THANK YOU VERY MUCH FOR YOUR ATTENTION.

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