Outlook for On-board and Cloud Diagnostics

Marcel Romijn (BRACE), Matthias Weber (Roben)
Will Cloud based diagnostics increase vehicle uptime?

1. Definitions

2. New Diagnostic Possibilities

3. Future Diagnostic Architecture and Cloud Infrastructure
Definition of „OBD“

Definition from UNECE*:

„OBD is a system on-board a vehicle which has the capability of detecting malfunctions, and, if applicable of indicating their occurrence by means of an alert system, or identifying the likely area of the malfunction by means of information stored in computer memory, and/or communicating that information off-board.“

- Emission related diagnosis
  - [CHECK]
- Functional safety regulation
  - [ISO]
- Workshop diagnosis

* UNECE TRANS/WP.29/GRPE (Working Party on Pollution and Energy)
Different Types of Diagnostics

Placement of diagnostics based on diagnostic levels and information need

- **System**
  - “Does the whole system act as it should?”

- **Plausibility**
  - “Does the value make any sense?”

- **Range**
  - Exceeding normal measurement range; in unit of the sensor

- **Electrical**
  - Short/Open circuits; usually all the Volt, Amps, Ohms things

Every diagnostic needs information

*The “monitored value” and enabling conditions*

Look at the source of the information
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Augmented Reality
Repair supported by Cloud Services

- Improved Maintenance speed due to access to real-world diagnostic data
- Enabling maintenance technicians
  - to assess specific OEM services,
  - learn from the experience of other technicians worldwide
  - enable shops to pre-stock most likely replacement parts.
- This will allow also remote shops to perform complex maintenance routines of the increasing variants of drivetrains.

Source: Continental Engineering Services GmbH
Extended Diagnostics
Novel Sensing Technology

- Running deep-memory algorithms that were not previously possible
- Using Amplitude and Frequency signatures for diagnostic detection
- E.g. Advanced analysis on crankshaft accelerations and decelerations
Opportunities
Decisioning Components on Big Data

Segmentation
- Segmentation to sub-group customers to treat differently, based on the context and relevancy of the problem

Data Enrichment
- Bring data into the context of the Decision Strategy. For instance recommendations from other Decision Strategies

Arbitration
- Add more data to the Decision Strategies, enabling to make recommendations more personalized and context sensitive

Aggregation
- Rank and filter causes and solutions. Filtering out irrelevant causes and prioritize the relevant solutions
- Calculate aggregate values such as an average for a range of values

Source: PEGA.COM

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Opportunities
Predictive Maintenance

BUSINESS DATA
- R&D
- Sales
- Asset Management

UNSTRUCTURED DATA
- Recordings
- Weather

MACHINE DATA
- Temperature
- Energy

Source: PEGA.COM

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Diagnostic Architecture: Today‘s Toolchain

Detection: Monitors
Handling: Fault manager
Reporting: HMI
Analysis: Diagnostic tool
Repair: Service workshops

Fault response / Safe mode
Diagnostic Architecture: Outlook II

Detection
- Monitors

Handling
- Fault manager

Reporting
- HMI

Repair
- Service workshops

Cloud analysis

Fault response / Safe mode
Vehicles have already become connected. Car2Car communication will be an add on.

**GPS**
- E-call emergency

**FM/AM/DAB+ & TMC**
- Internet connectivity
  - Car-to-Infrastructure
  - Remote start
  - Remote open/close
  - Internet radio
  - In-car WiFi hotspot
  - Updates over the air
  - 3rd party apps
  - Remote diagnostics

**OBD connector**
- w/ dongle to internet

**Parking sensors**
- Ultrasonic

**Driver support:**
- Rain sensor
- Light sensor
- Camera

**Infotainment:**
- USB
- AUX
- CD/DVD
- iPod
- Bluetooth

**Active safety:**
- Forward radar
- IR laser & camera
- Rear/side radar

**Keyless entry/start**
- Radio signals

**Tyre pressure TPMS**
- Radio signals

**Source:** BRACE Automotive

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The world of telematics, remote diagnostics, etc. is not new. Standards are in existence already:

- CAN-bus / LIN-bus / Flex-ray / Ethernet related standards by SAE and ISO
- Bluetooth / GSM / WiFi related standards by ISO
- OBD standards by SAE and ISO; SAE J1979, SAE J1978, SAE J1699, SAE J3005
- Service tool standards by SAE and ISO; ISO 14229 (UDS)
- Data exchange and interpretation standards: ODX, OTX

But with the IoT there are Requirements for Additional Standardization!

e.g.: Current CAN-bus protocol has no Authentication Routine!

Source: OBD4HDD.ORG
Use-Cases and Stakeholder for Connected Vehicles

- Today’s standards for Automotive Communication in the Vehicle especially Diagnostic Communication didn’t expect a direct connection to the Internet of Things and the cloud itself.

- A trained technician with test equipment was considered to connect via the “CARB” connector to the Power train domain. This should guarantee that this interface is not misused.

- This assumption is no longer valid. Free available OBD dongles which are “bombarding” this interface with high frequency requests may lead to bus overload like a denial of service attack.

"Jail breaking" of infotainment systems is already happening”

Source: OBD4HDD.ORG
Use-Cases and Stakeholder for Connected Vehicles

- Hackers have been using IoT devices to get access to intranets, email, social media, credit cards and bank accounts. Vehicles fit in there as well.

- Researchers have proven that Internet connectivity and OBD dongles can provide open access to the CAN bus; meaning a full vehicle control. Think Corvette OBD dongle hack; think Jeep hack.

- Government agencies are preparing and the US Senate is discussing an Vehicle Cyber Security Act that requires safety relevant and non-safety relevant systems to be isolated from each other.

Source: OBD4HDD.ORG
Vehicle Interaction with the Cloud
Safety vs Security, Involved Domains and missing Gate Keeper

Source: OBD4HDD.ORG

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Future Diagnostic Architecture
Cloud Interface with Layered Security

Basic tasks of a Cloud Interface would be:

- Connect the vehicle securely to the cloud infrastructure
- Handle all communication and data streams from end-2-end
- Provide a kind of session management
- Protect the powertrain and chassis domain -> “Safety Wall”
- Protect the vehicle against unwanted communication -> “Security Wall”

Source: OBD4HDD.ORG
Why there will be the need for a new Certification

Current organizational Structure of Automotive Companies in Powertrain, Chassis und Interior does not support cross domain developments

Specialist are available but locked into existing structures

Development Cycles are long (years instead of weeks)

Product life cycle >10 years! How to upgrade ?

No experience or best practices for Connected Vehicles!
Why there will be the need for a new Certification

Current Certifications:

- Emissions (Exhaust & Noise & EMC)
- Diagnostics OBDII (Carb / EPA / EU ....)
- Development Processes (IEC 65108, ISO26262 and ISOTS16949)

Cars getting certified by Standards which don’t consider being connected to the Internet!

Connectivity introduces Issues into the Automotive World which are not covered by todays best practices and organizational Structures!
Statement of US Senator Ed Markey:
Massachusetts, February 15th, 2015

“These findings reveal that there is a clear lack of appropriate security measures to protect drivers against hackers who may be able to take control of a vehicle or against those who may wish to collect and use personal driver information.”
Conclusion

- Extended (Cloud) Diagnostic provides new Detection Strategies and support
  - Improved pin-pointing algorithms, predictive maintenance, repair shop support
- This will improve clearly the vehicle uptime
- Existing standards, software cores, tools, connector will overlap with new capabilities
- A Future State of the Art: more robust & tolerant against hacking
  - Be sure that it will be higher than for cell phones and PlayStation4
- Standards and proposals to-date target “Data Security” State-of-the-Art
  - but not “Safety” State-of-the-Art
- Flexibility has always to be balanced against Safety and Security
  - Flashing is a top security threat, OTA (over the air) seems inevitable,
    - “Right to Repair” further complicates

“… many manufacturers did not seem to understand the questions posed by Senator Markey.”