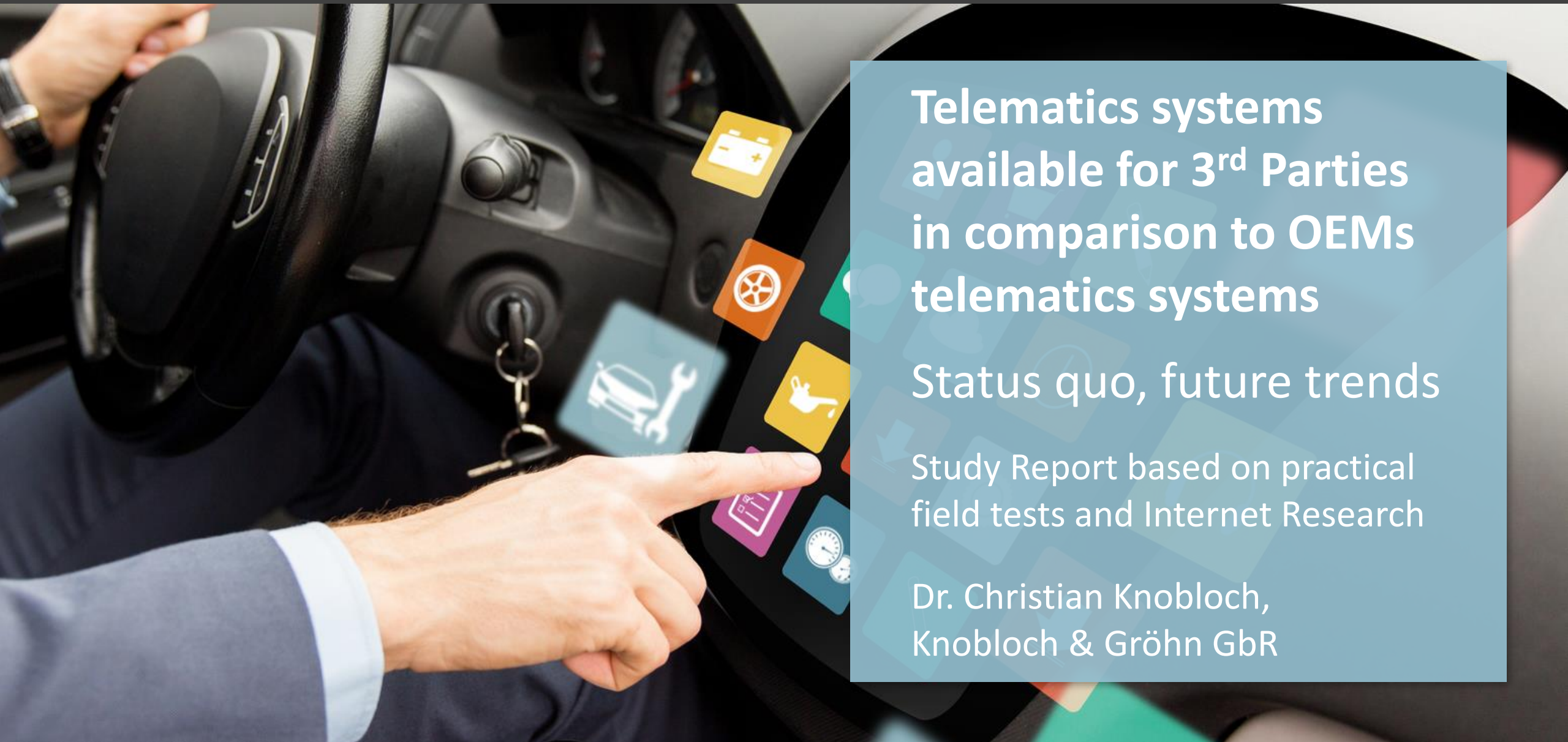
The Connected Car – Study – 20th November 2018



Telematics systems available for 3rd Parties in comparison to OEMs telematics systems

Status quo, future trends

Study Report based on practical field tests and Internet Research

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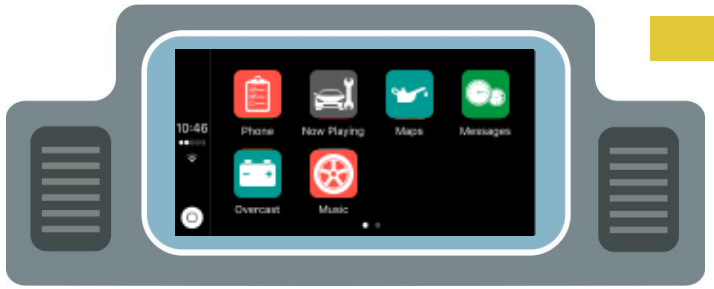
Prerequisite

The foundation for any aftermarket and mobility services business in the digital age is a fair and equal access to:

1.

To the Customer in the car



Bidirectional communication with the customer:

1. Offer services
2. Control service execution

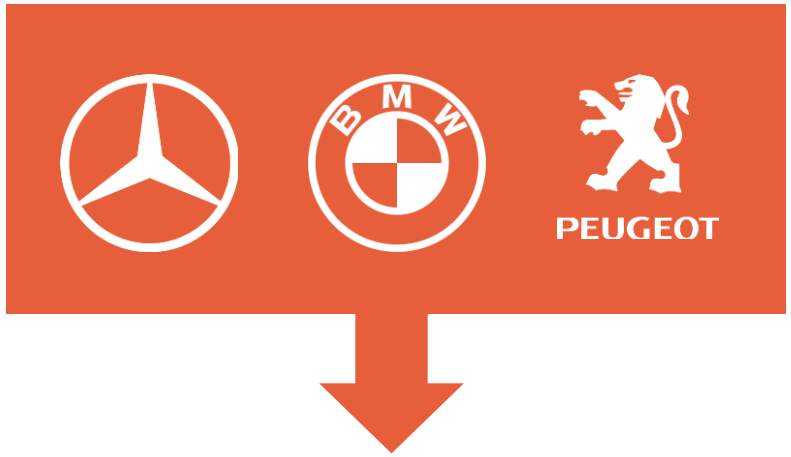
2.

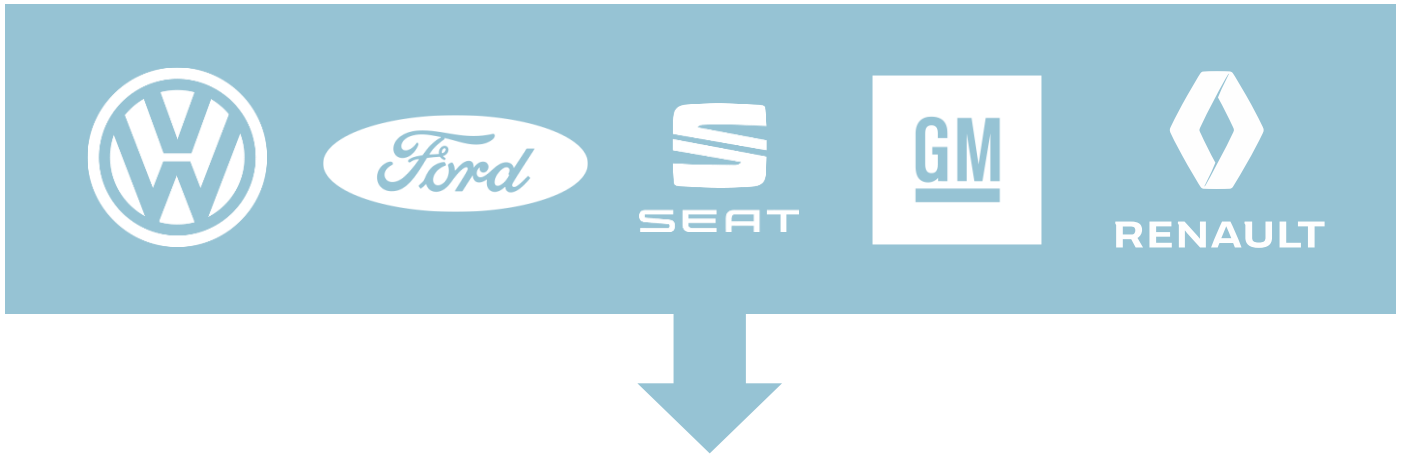
To the car itself

Bidirectional communication with Car-ECUs.

1.Detect service needs(Read DTCs)
2.Execute services (reset DTCs)

Overview: of examined OEMs with alternative remote access models:





Off-board data access models
Extended Vehicle (ExVe)

On-board data access models

Methodolody:

- Internet research/documentation and first tryouts of developer programs
- In depth sample field study for 2 technologically advanced OEMs (own telematics systems vs. ExVe).

As a start:

What can OEMs do with their own proprietary in-vehicle telematics systems?
Results of a sample field study for a Mercedes and BMW car.

What OEMs can do with their own in-vehicle telematics systems? – BMW Example for breakdown service

A: Detect problems due to diagnostic software in the vehicle.

Actual vehicle fault indicated by malfunction indicator light (MIL) to the driver.

OEM advantage: Privileged access via embedded diagnostics software.

B: Analyse problems remotely via a remote access to the embedded diagnostics software.

Analyse problem remotely in detail via activation of remote online connection and a bi-directional communication with the OEM-diagnostics software in the vehicle.

What OEMs can do with their own in-vehicle telematics systems? – BMW Example for breakdown service

C: Bi-directionally communicate with the vehicle driver to offer services and to support remote test functions

Capability to direct the driver to the OEM‘s own (more distant) subsidiary (despite the fact that the test car was intentionally parked just a few meters away from an authorised BMW repairer)

What OEMs can do with their own in-vehicle telematics systems? – Mercedes example for Maintenance service

D: Exclusive direct access/communication with driver...

Inform driver about upcoming service need safely via the dashboard.

E: ...based on remote monitoring with OEM applications in the car

Prompt driver with a precise service offer and concrete price quote for the service and spare parts (e.g. oil change, filter) based on the information gathered remotely from the car, flagged up at ‚62.821 KM' (which is a flexible service interval based on detected brake pad wear etc.).

Das Angebot basiert auf der übermittelten Laufleistung von 62.821 km.

Beschreibung	Ihr Preis (EUR)
Service A mit Plus-Paket durchführen • Zustand der Fahrzeugaußenseite prüfen • Zustand der Frontscheibe prüfen • Zustand der Wischerblätter prüfen • Kühlmittelstand Hauptkreislauf prüfen • Zustand und Profiltiefe der Reifen beurteilen • Zustand der Bremsbeläge beurteilen • Zustand der Bremsscheiben beurteilen • Zustand der Fahrzeugunterseite prüfen (optional) • Warn- und Funktionsleuchten im Kombiinstrument prüfen • Signalhorn auf Funktion prüfen • Kartendatenstand aus Navigationssystem auslesen, Aktualisierung prüfen • Wartungsdaten aus Kombiinstrument auslesen, notieren und Serviceanzeige zurücksetzen • Bremsentest auf Prüfstand durchführen • Bremsanlage - Flüssigkeitsstand prüfen • Leuchten im Kombiinstrument und Innenbeleuchtung prüfen • Reifendruck richtigstellen • Reserverad Reifendruck prüfen, richtig stellen oder Reifendichtmittel TIREFIT - Verfallsdatum prüfen • Verbandstasche - Verfallsdatum prüfen • Kofferraumbeleuchtung auf Funktion prüfen • Scheibenwaschanlage - Flüssigkeitsstand prüfen, richtigstellen • Motor: Öl- und Filterwechsel	322,47
Panorama-Schiebedach: Führungsmechanik säubern und schmieren	35,95
Ihr Gesamtpreis (EUR)	358,42

Summary: What OEMs can do with their own in-vehicle telematics system?

Summary:

In both the vital service areas of the Aftermarket and of Mobility Service, the OEM has already a privileged position: Earlier and better access to the driver plus a privileged and better access to the vehicle and its data and functions.

As a comparison:

What do OEMs offer to 3rd party service providers?
Now and in the future (planned) –
To both an open or to a restricted set of chosen 3rd party service providers.

Overview: Current OEM ExVe data access for thirds parties

Nothing available at all

- Audi
- Seat
- Renault
- Fiat
- Chrysler
- Toyota
- Honda
- Hyundai
- KIA

Off Board-Solutions today (existing ExVes)

- BMW Car Data
- PSA ExVe

Off Board-Solutions planned (ExVes Beta version)

- Mercedes ExVe

First Myth:

ExVe is not as widely spread in the market as advertised by OEMs!
No indications that OEMs would deliver practical access of Independent Operators

Availability of current OEM ExVe data access for 3rd parties

So, let’s have a closer look at what current ExVe models can deliver!

Example: BMW – ExVe

Data:

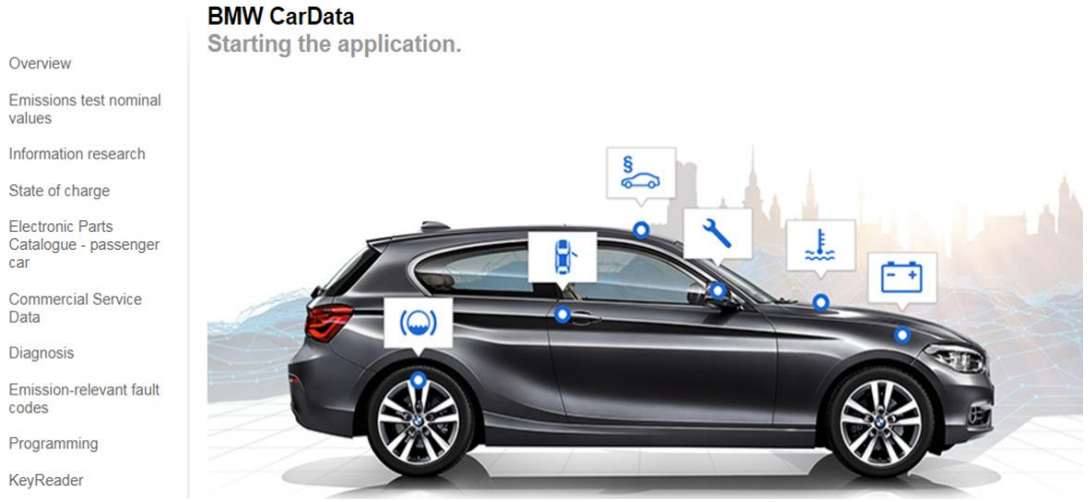
- No access to Customer in the vehicle (just Smartphone, ExVe model)
- 80 data points, but only 11 for Repair & Maintenance (RMI)
- Sampling rate not stated in the report, according to tests values are transmitted only once per “Ignition off”- Event

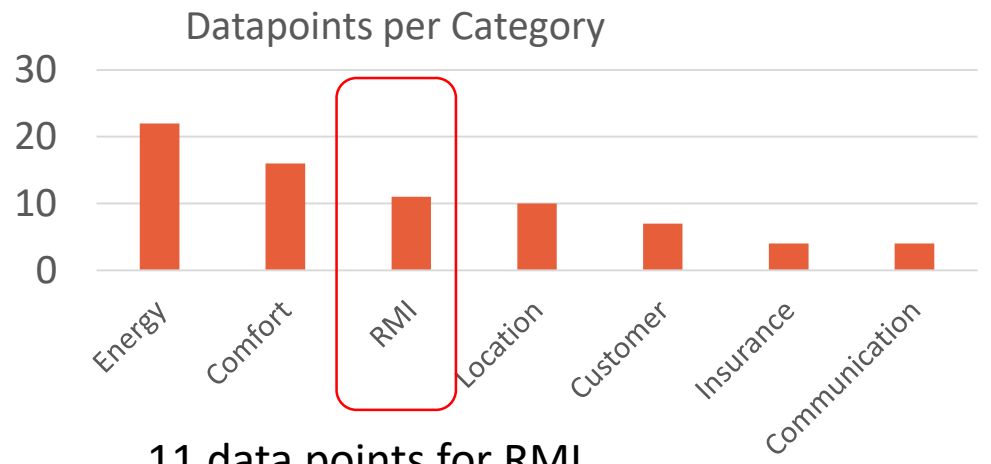
Missing:

- Real time access
- Access to customer
- Ability to trigger in-vehicle functions

Conclusion:

- Just 11 RMI data points (compared to 7.000 – 10.000 currently available in-vehicle and needed for independent diagnostics)





11 data points for RMI

Example: Mercedes ExVe (public beta version)

Data:

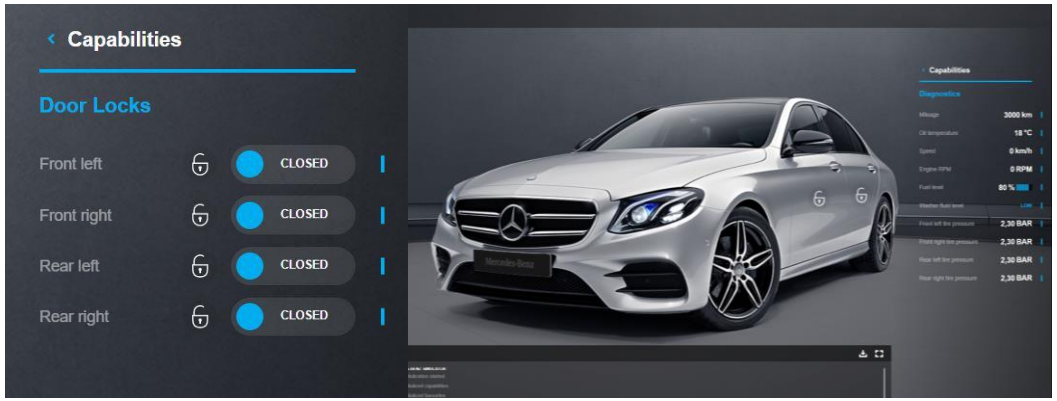
- No access to customer in the vehicle (just Smartphone, ExVe model)
- Functional access control for Door (lock/unlock) possible
- 23 data points accessible
- Sampling rate unknown

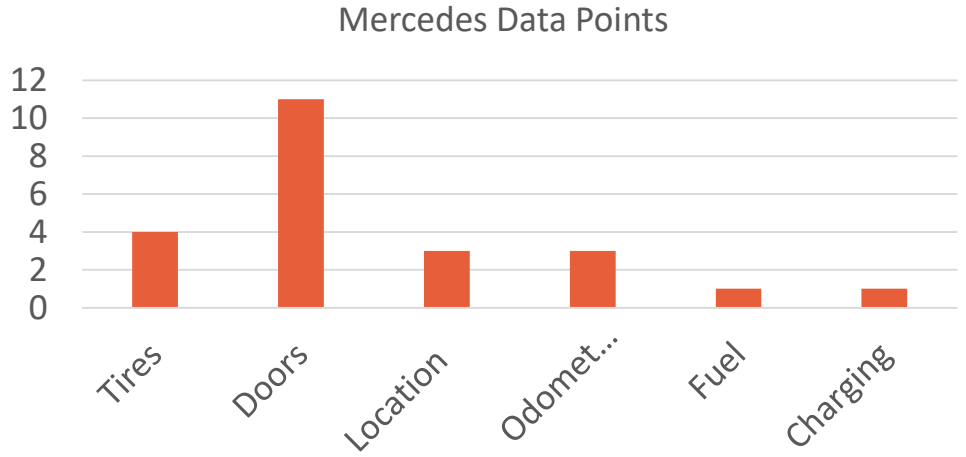
Missing:

- Real time access.
- Access to customer.
- Ability to trigger actors/actions despite the doors.

Conclusion:

- Just 23 data points, no contact with driver via dashboard.





Example: Peugeot/PSA – ExVe

Data:

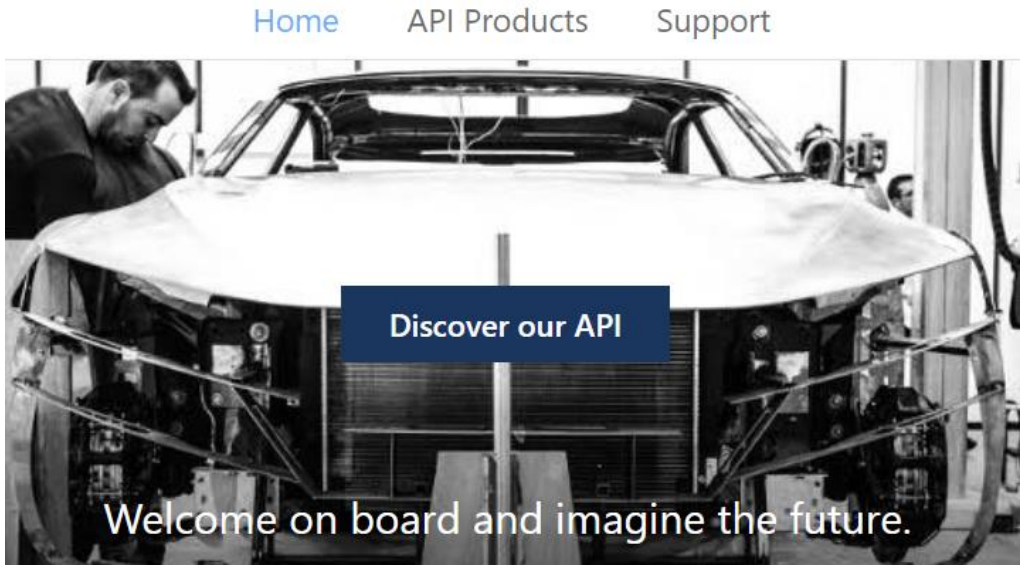
- No access to customer in the vehicle (just Smartphone, ExVe model)
- “More than 89” (actually counted in analysis 107) data points, but only 18 for RMI
- Sampling rate: once per second for some data points (at best), but transmitted only after 1 minute of collection

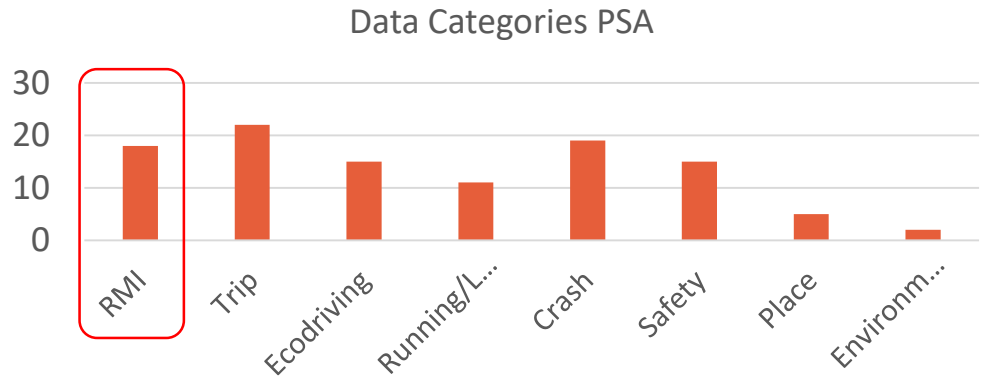
Missing:

- No real time access.
- Access to customer. (Only via smartphone)
- No access to vehicle resources

Status:

- Since market hit in 2016, no significant evolution observed. Development seemed paused.





18 data points for RMI

What are current ExVe models able to deliver?

Conclusion:

Off-Board ExVe models are small in number and severely limited in functionality and extent of data.

That Extended Vehicle is a model whereby vehicle manufacturers share equally vehicle data and functionalities – This is another **myth** which we hereby demystified!

Overview: Existing and developing OEM on-board solutions

Let's now look at what other models for vehicle and driver access e been implemented (or are under final development)

Overview of existing and developing OEM on-board solutions

On-Board-Solutions today (Access conditions controlled by OEMs):

- GM Next Generation Infotainment (NGI)
- Smart Device Link (SDL) Members (Ford, Toyota, Mazda, Suzuki, Subaru, Nissan, PSA, Isuzu, Daihatsu, Mitsubishi)
- Apple/Google/MirrorLink
  Example SEAT using Apple Car Play for it‘s own Repair and Maintenance App.
- (Annotation: Toyota had a platform idea similar to GM NGI in 2014, but apparently not gained much interest, thus T-Connect now is from the outside just another OEM-app.)

On-Board-Solutions planned

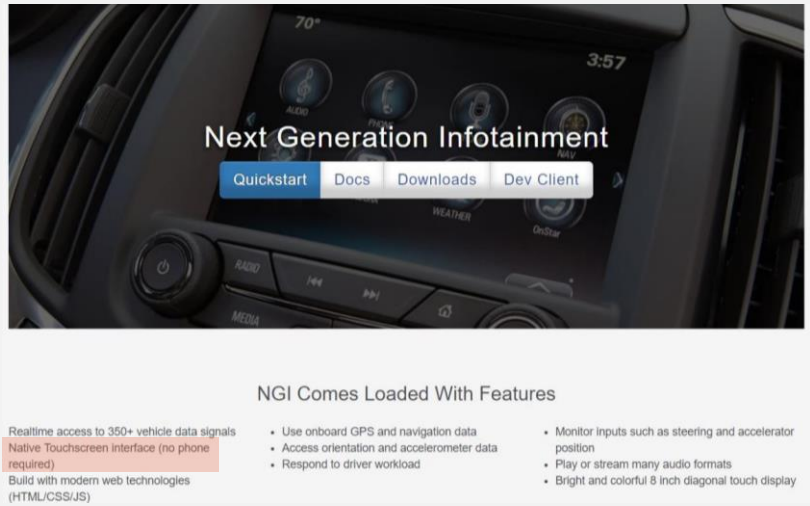
- Volkswagen et.al (e.g. Mitsubishi) ‘VIWI’
- Audi/Volvo: New Versions of Google (Android car) integrated deep into new cars.

Example existing on-board solution: General Motors (GM) Next Generation Infotainment (NGI)

On-board solution in the car:

Native Touchscreen Interface (No Smartphone).
Integrated with Speech recognition:

Native Touchscreen interface (no phone required)



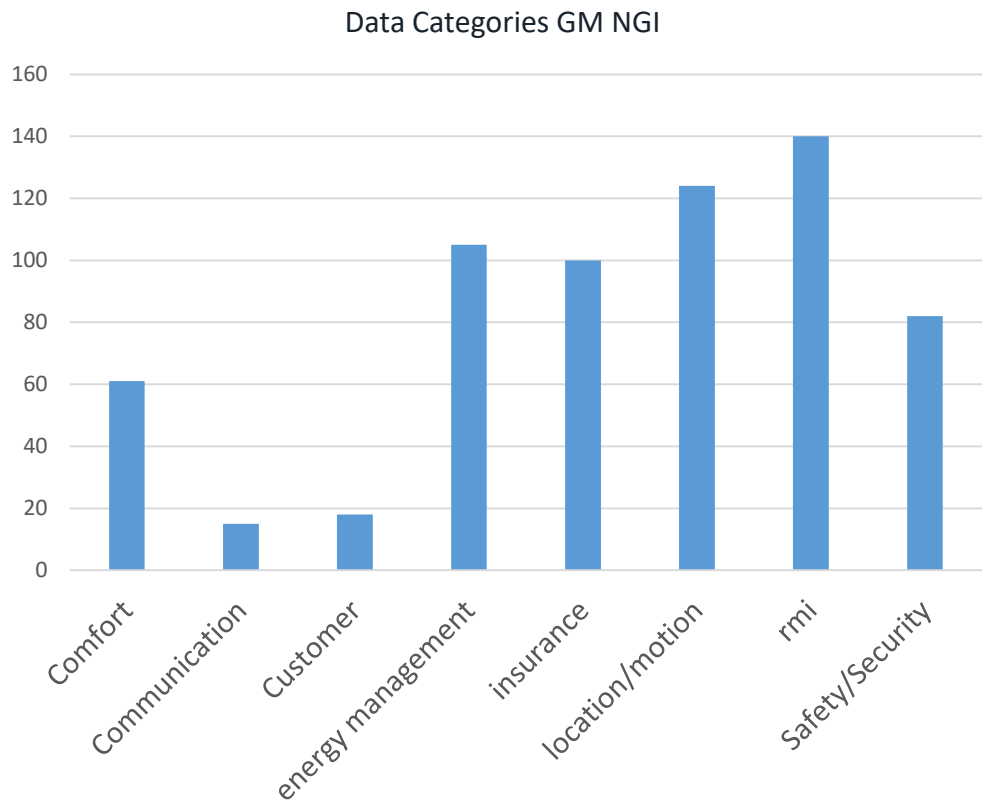
This shows: Full and equal (in comparison to the OEM) access to the driver is possible already now!

Example existing on-board solution: General Motors - NGI

Summary:

- Equal access to the driver is possible.
- Access to real time signals is possible (e.g. ABS signals, accelerator position)
- Secure and standardised process of app development, test and release using open standards is possible.

- Write access to the car still limited as well as access to full data set needed for truly independent repair and mobility services

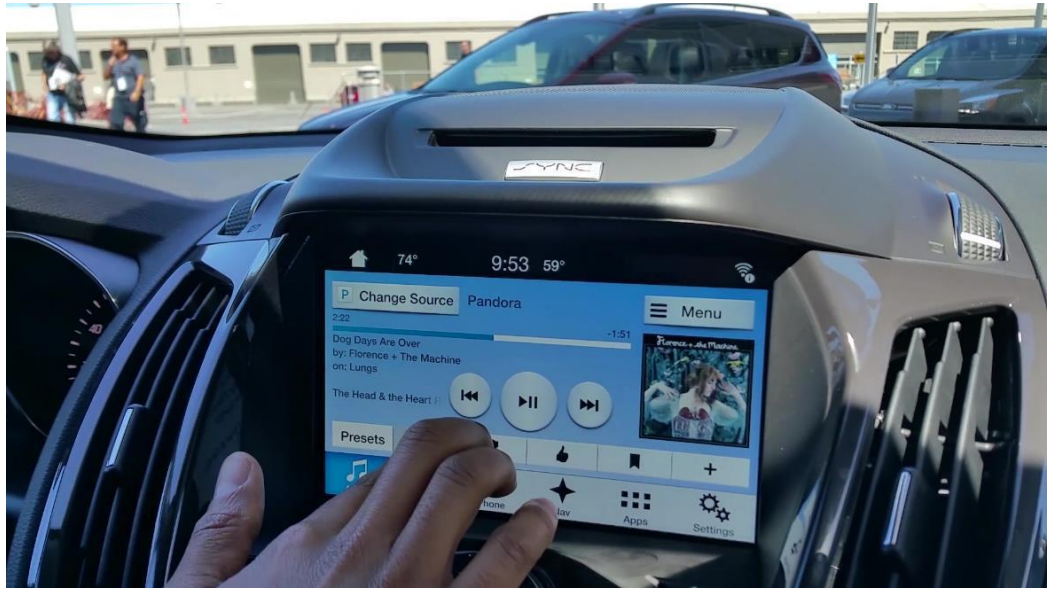


Example: Just 2 out of 400+ data points available

Example existing on-board solution: Ford (+ consortium of 10 OEMs) Smart Device Link (SDL)

What it looks like:

- Structure:
  Same as for an interoperable OTP.
- An open consortium develops the standard and conducts both the initial testing and ultimate testing of Apps, and thus the responsibility remains with each implementing OEM.



Current limitations:

As of now, the consortium focusses on driver interaction and ‘fun’ Apps around media players etc.
But: deeper access foreseen: Read Diagnostic IDs, read Diagnostic Trouble Codes

As in any standardised interface – e.g. an OTP, Carplay or Android Auto, it should be possible to write once in SDL, then have the App run on every supported car.

Example existing on-board solution: SDL - diagnostic service call

GetDTCs

This RPC allows you to request diagnostic module trouble codes from a vehicle module. HMI Status Requirements

HMILevel needs to be FULL, LIMITED, or BACKGROUND.

Request

Name	Type	Description	Reg.	Notes	Version
ecuName	Integer	Name of ECU.	Y	Min Value: 0 Max Value: 65535	SmartDeviceLink 2.0
dtcMask	Integer	DTC Mask Byte to be sent in diagnostic request to module.	N	Min Value: 0 Max Value: 255	SmartDeviceLink 2.0

Get Diagnostics Trouble Codes

With this functions (and the related one for Read Diagnostic IDs), the SDL potentially offers an unprecedented (albeit not standardised) depth of access for in-vehicle data. The diagnostic tool provider still needs to know the ECU numbering and DTCs, but at least he can extract them now safely and remotely via an SDL-app.

Caveat: SDL-Member OEMs individually decide if they want to support this functionality.

Example existing on-board solution: SEAT using Apple Carplay for its own Repair/Maintenance-APP

1. Start SEAT-APP as a normal Carplay-APP

2. Watch your car‘s status

3. Get informed about Service needs in the vehicle directly

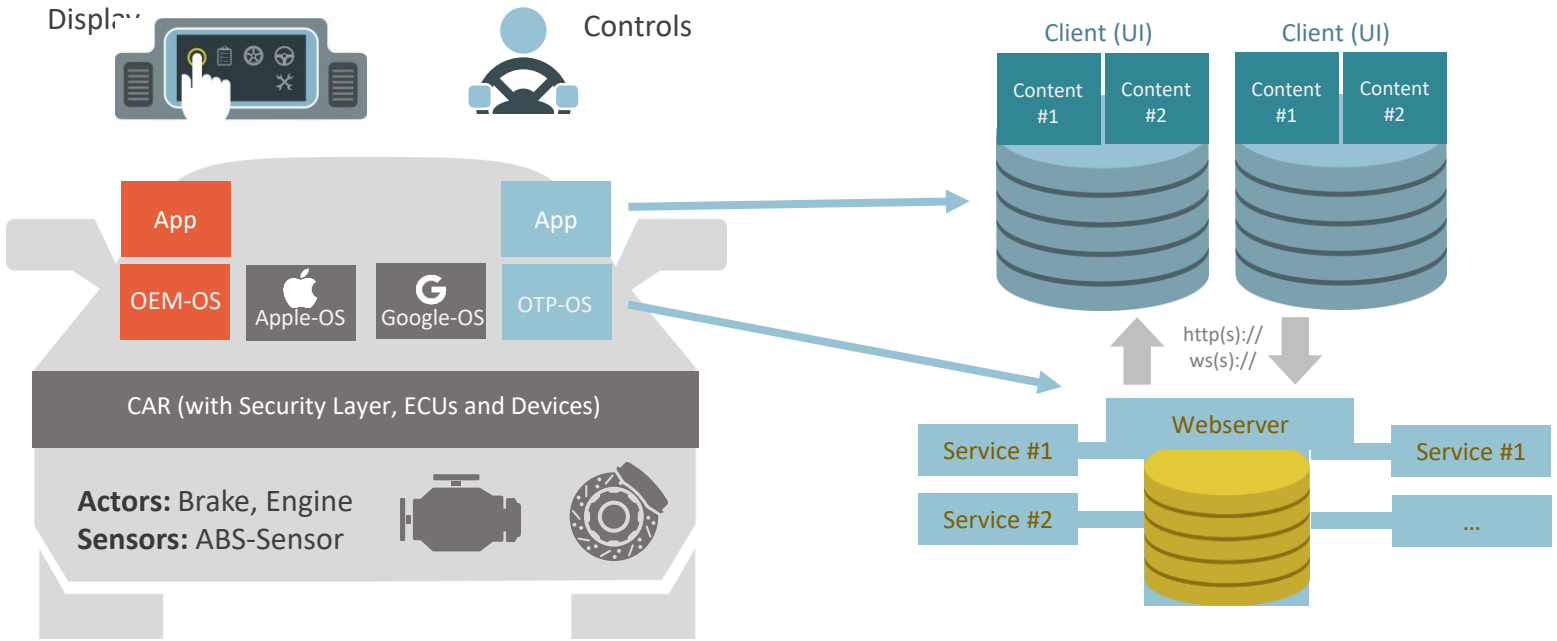
4. Get your service by an OEM workshop

Future Trends: What's to come next?

These presented models are already available today.

Let's now examine some future trends.

Example planned on-board solutions: Volkswagen – 'VIWI'



- VIWI is a Webservice based 'open' telematics platform. It is another approach for a future Open Telematics Platform.
- It is already submitted to the W3C (World Wide Web Consortium) Automotive group for standardisation! (13 Dec. 2016)
- It offers secure real-time access to in-vehicle functionalities and resources.
- In terms of standardisation and openness, as close to a standardised Open Telematics Platform so far seen.

Example planned on-board solutions: :Volkswagen – ‘VIWI‘

Until now (and depending on the way to count the signals), VIWI offers 124 data points for in-vehicle data alone.

Extract of data points / Details for car/service

typeOfService	The service data are related either to inspection service or to oil service.	string			inspection oil airFilter oilFilter
distance	The distance in miles or kilometers when the service is due or since the service is overdue. If the service is overdue, then distance < 0. If the service is due today, the distance == 0. If the service is due in <x> km or mls, then distance == x.	integer			[-204700..204700]
distanceunit	the variable unit belonging to the property 'distance'	string	distance		-
time	The time in days when the service is due or overdue. If the service is overdue, then time < 0. If the service is due today, the time == 0. If the service is due in <x> days, the time == x.	integer		d	[-2048..2048]
intervalReset	the interval to be or being reset in a comma separated list	array			distance time

Planned on-board solutions:
Deep Integration of Google into the car by Audi and Volvo

Google API snippet:
(https://developer.android.com/reference/android/car/VehiclePropertyIds#OBD2_LIVE_FRAME)

```
OBD2_LIVE_FRAME = (
    0x0D00
    | VehiclePropertyGroup:SYSTEM
    | VehiclePropertyType:COMPLEX
    | VehicleArea:GLOBAL)
```

First OEMs build their future remote services systems on Google Android into the car with in-depth access to in-vehicle data.
Look and feel of the HMI will be specific to each OEM, but the technology and data access behind will be Android.

Comment: If this will be a success, then Google will become the future Open Telematics Platform!

So is ExVe the best access model for 3rd party service providers?

Conclusion:

ExVe is not the predominant system in the market – this is a myth!

Instead, there are many more examples which demonstrate a strong push towards the development of in-vehicle on-board-solutions!

Summary of Findings of the Study:

- Off-Board ExVe solutions are small in number and severly limited in their functionality and extent of data and do not provide equal access to the in-vehicle data.

- Strong push towards in-vehicle on-board-solutions for OEM + their chosen third parties offering full access to the driver and a potentially unlimited access to the car (depends on OEM's willingness to connect in-vehicle systems in a safe & secure way to the APIs):

    - Single OEMs (GM – NGI) trying to attract more developers and apps.
    - Some OEMs (Ford, Toyota et. al) try to set up a consortium for an open on-board application platform to attract more developers within SDL
    - Other OEMs (Volkswagen et al. e.g. Mitsubishi) already submitted first drafts for a real standardised world wide Open Telematics platform to the W3C (VIWI).

Summary of Findings of the Study:

- Summary: Technically and from a security standpoint, a variety of on-board solutions are viable options.
- However, the OEMs have a tight grip on the admissions and permissions of 3rd party developers to these solutions.
- Legislation will be needed, if every legitimate stakeholder should have a Right2Business and a right to access these solutions.

Thank you for your attention!

Dr. Christian Knobloch,
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