

Eclipse KUKSA.val for SCR Anti-Tampering Monitoring in Heavy Vehicles

Junhyung Ki^{*}, Sebastian Schildt[△], Andreas Hastall[△], Sven Erik Jeroschewski[■],
Robert Höttger^{*/◇}

^{*} Dortmund University of Applied Sciences and Arts / [△] Robert Bosch GmbH /
[■] Bosch.IO GmbH / [◇] Materna Information & Communications SE

OULU
AUTOMOTIVE
CLUSTER

OULU | *BusinessOulu*

THE PROBLEM

Introduction

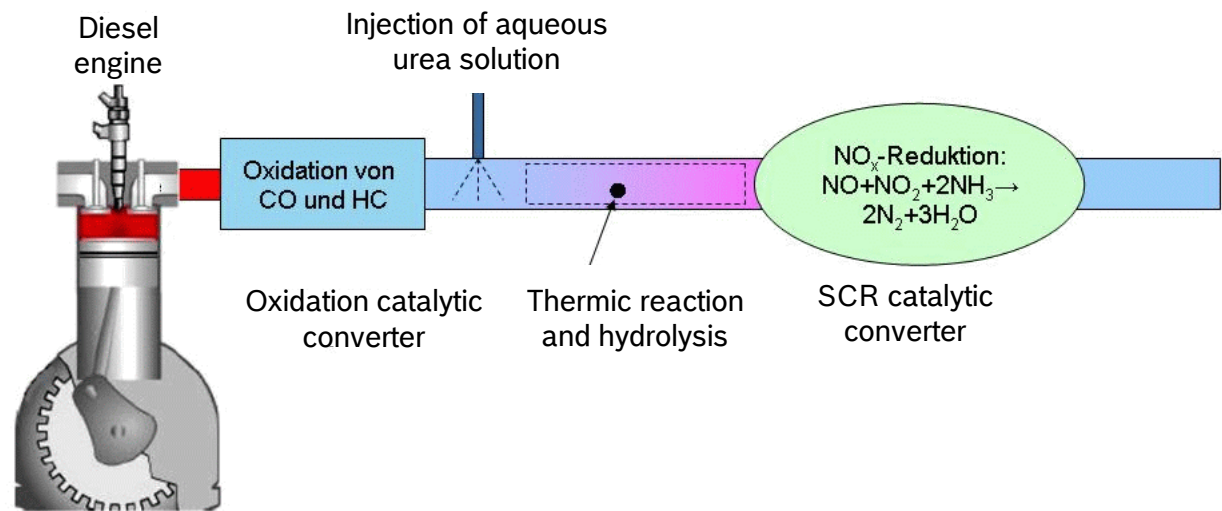
Diesel Exhaust Treatment

- Diesel Engines use “Selective Catalytic Reduction” (SCR) as part of the exhaust treatment system
- The SCR system converts harmful nitrogen oxides (NO_x) from the exhaust gas into Nitrogen (N_2) and Water (H_2O)
- This reaction requires ammonia (NH_3) that needs to be fed to the system. This is usually done in form of a urea solution (marketing name “AdBlue”)
- Required to meet legislated emission standards



For more technical details check:

https://dieselnet.com/tech/cat_scr_diesel_urea_dosing.php



The Danger Tampering

- AdBlue is a cost factor: It can add 1500USD/year operating cost to a commercial vehicle
- Without AdBlue a legally compliant truck will not start

The cost provides an incentive to ***tamper*** with the system

- Deactivating parts of the SCR systems and related sensors
- Sending fake data on vehicle busses to prevent the on-board systems to detect it
- This is nearly impossible/time consuming to detect by traffic police



Esso AdBlue pump by Cjp24 under CC BY-SA

The Problem It is Cheap

By continuing to use AliExpress you accept our use of cookies (view more on our Privacy Policy). You can

Sell on AliExpress | Cookies

AliExpress

AdBlue Emulator

Related Searches: emulator

All Categories > "AdBlue Emulator" (811 Results)

Price: min - max Ship from

Sort by: **Best Match** Orders Newest Price

Filter for the right parts for you

Related Categories:

- Automobiles & Motorcycles
- Car Diagnostic Cables & Connectors
- Engine Analyzer
- Air Bag Scan Tools & Simulators
- Tools
- Consumer Electronics
- Home Improvement

Brands:

- CARTOOL

Language:

- english
- Spanish
- French
- Italian
- Russian

View More

AliExpress Mobile App



**Adblue Emulator 8 types For D-A-F/Ive-co
For Be-nz/Ren-ault/Fo-rd/M-A-N/Sca-nia/Vo-l-vo**



AdBlue Emulator EURO 4/5/6 OBD2 OBDII AdBlueOBD2 OBD2 NOx Ad blue Emulato
r for Scania for DAF for Renault for IVECO for Volvo

★★★★★ 4.6 62 Reviews 198 orders

US \$29.00 ~~US \$36.25~~ -20%

After discounts: **US \$28.00**

Instant discount: US \$1.00 off per US \$20.00

Color: for M-B for Be-nz

for M-B for Be-nz

for M-A-N

for D-A-F

for I-VE-CO

for Sca-nia

for Ren-ault

for VO-L-VO

for Fo-rd

Quantity:

1

Additional 2% off (3 pieces or more)
16 pieces available

Free Shipping

to Germany via AliExpress Standard Shipping

Estimated Delivery on Jul 01

Buy Now
US \$28.00

Add to Cart

216



Hot!!! Newest Adblue 9 in 1 A&B C...

US \$21.60

6 sold

Super Obd store



Adblue Emulator 7in1 Full Chip Ver...

US \$15.57

5 sold ★ 5

Free Shipping Free Return

BestOBD2 Store



5pcs/lot Newest 9in1 Universal Ad...

US \$130.20

23 sold ★ 4.3

Free Shipping

CARATDIAG Store



OBD2 Adblue 9 In 1
OBD2 Adblue 8 In 1

10PCS Full Chip Adblue 9 IN 1 Emu...

US \$222.00

3 sold ★ 5

7-Day Delivery Free Shipping

SuperTool Store



9in1 OBD2 Adblue Emulator for Co...

US \$31.00

3 sold

Free Shipping Free Return

Automobiles Tool Store

TO OBD2 adBlueOBD2 9 IN 1

OBD HOME Adblue 9 in 1

ReDiag Adblue obd2 Emulator

8 In 1

ATODG

WORKING ON A SOLUTION

DIAS Project

Diagnostic Anti-Tampering Systems



Malicious tampering of environmental protection systems like SCR turns very clean vehicles in heavy polluters. In the European project DIAS, countermeasures are developed to harden vehicles against tampering.
11 partners from 7 countries.



BOSCH

Robert Bosch GmbH
Germany



BOSCH

Robert Bosch AG
Switzerland

TNO innovation
for life

FORD **OTOSAN**

icct THE INTERNATIONAL COUNCIL ON
Clean Transportation



iti Information
Technologies
Institute



GEORGE EMIL PALADE
UNIVERSITY OF MEDICINE,
PHARMACY, SCIENCE, AND
TECHNOLOGY OF TARGU MURES

VUB VRIJE
UNIVERSITEIT
BRUSSEL

A thorough two-level plan to stamp out tampering
DIAS starts with current OBD and follows a two-level approach. The first level is the development of an enhanced OBD system, assessing its resistance to tampering and creating intermediate regulatory guidelines. The second level will be the development of more advanced cloud-based diagnostics systems involving two-way communication that foresees swift tampering detection.

<https://www.dias-project.com>

Eclipse KUKSA

Software Components for Connected Vehicles

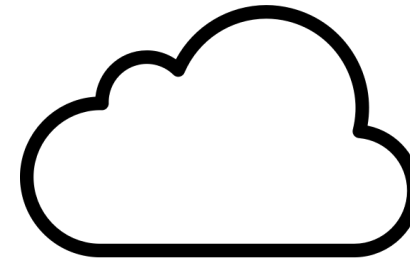


“The open Eclipse KUKSA project aims to provide standardized software building blocks for connected car ecosystems that can be shared across the industry, providing performance, quality and scalability for base services that can act a solid foundation for a variety of competing products and services.”



In-vehicle components

- KUKSA.val V(I)SS dataserver
- KUKSA.hardware



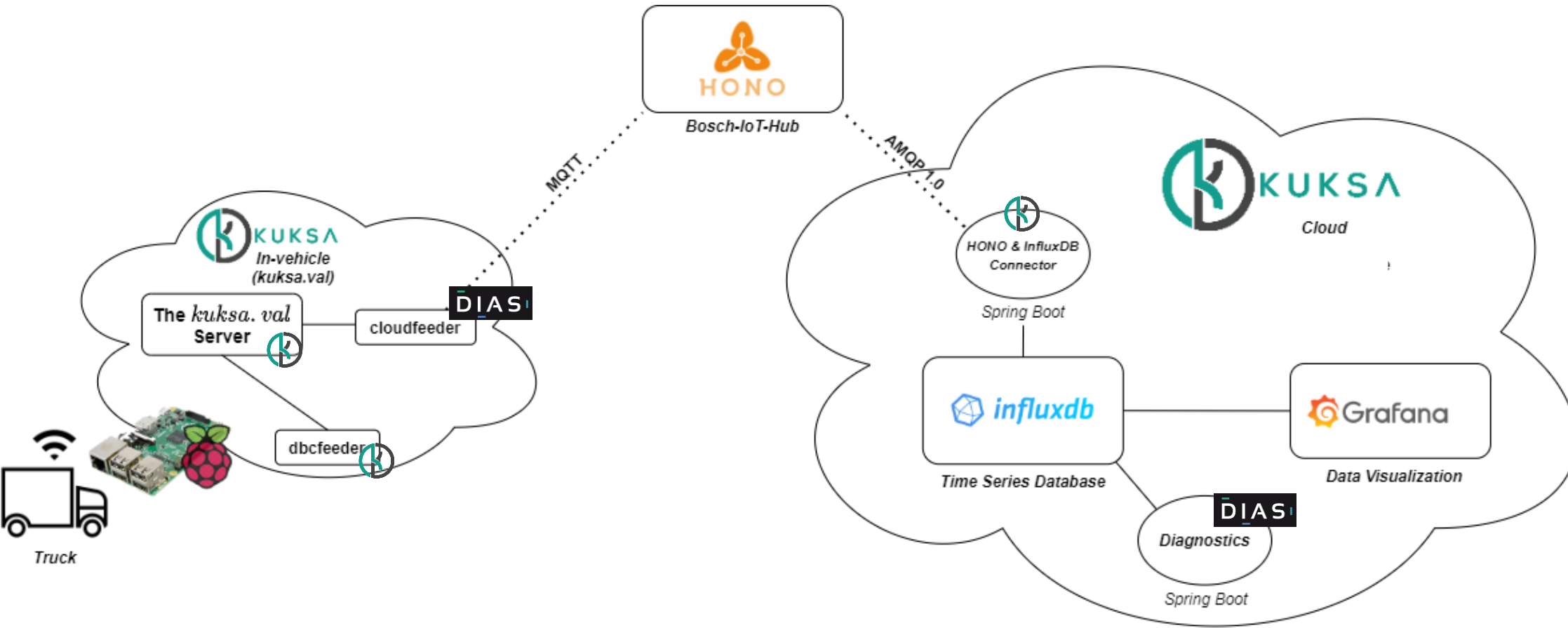
KUKSA.cloud

- Distribution of services for connected vehicles
- Relying on Eclipse IoT technologies

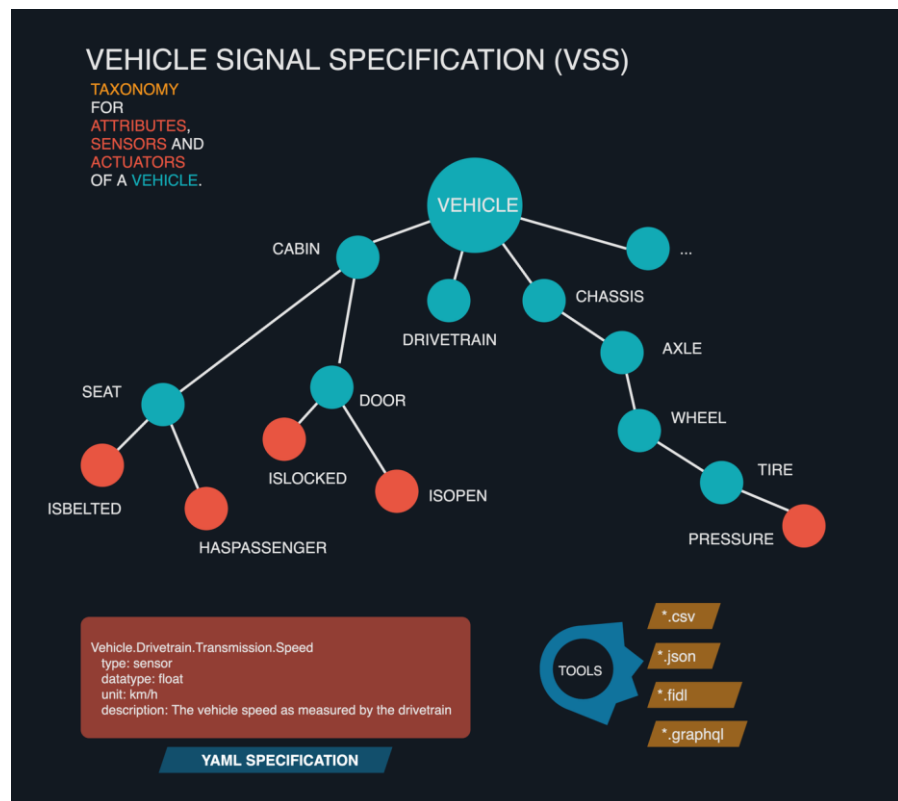
<https://www.eclipse.org/kuksa/>

OUR APPROACH

SCR Anti-Tampering with KUKSA System Overview



SCR Anti-Tampering with KUKSA Genivi Vehicle Signal Specification



- Introduces a domain taxonomy for vehicle signals
- Creating a common understanding of vehicle signals in order to reach a “common language” for vehicle data independent of protocol or serialization format.
- Cooperatively created by various industry players
- Completely open

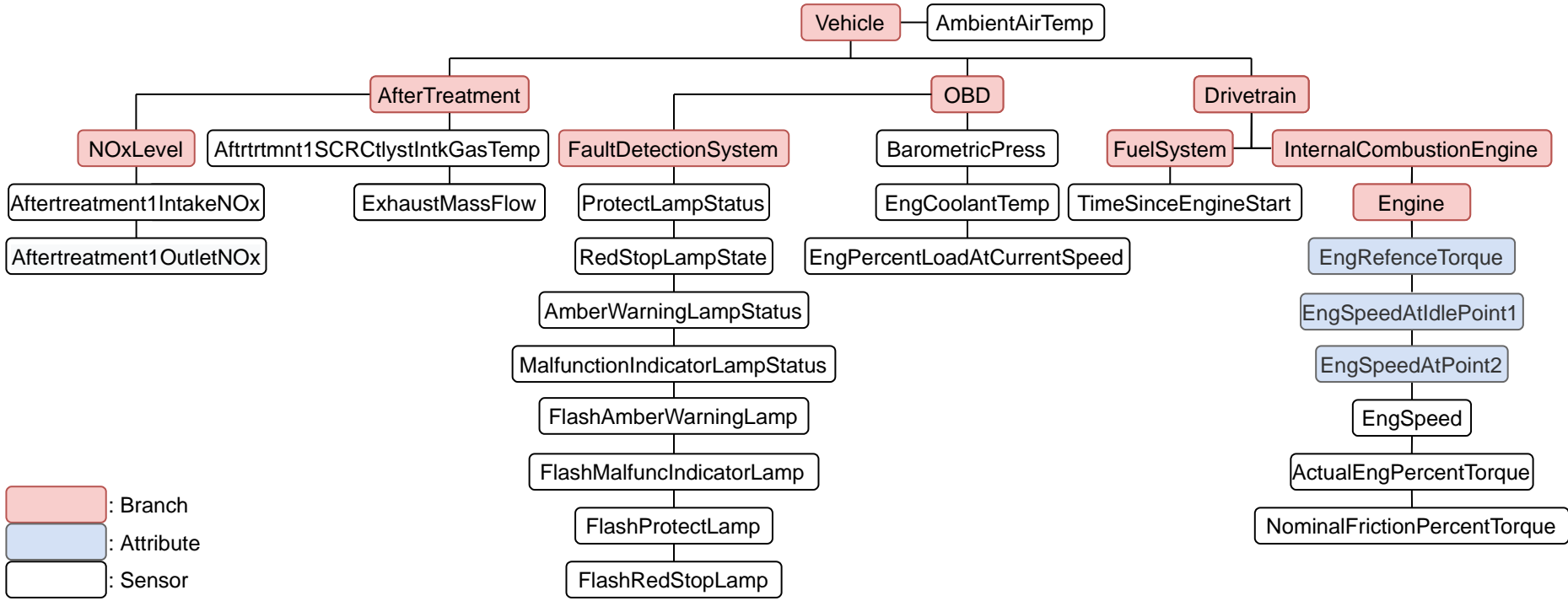
Example: Vehicle.Powertrain.Battery.Temperature

```
"Temperature": {
  "datatype": "float",
  "description": "Temperature of the battery pack",
  "type": "sensor",
  "unit": "celsius",
  "uuid": "2b9d90f1d87c57dcbbd6a72807f8d412"
}
```

https://github.com/genivi/vehicle_signal_specification

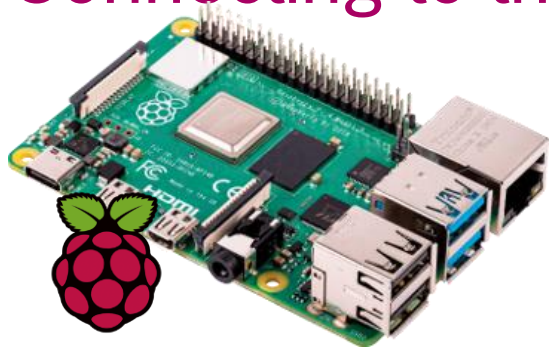
SCR Anti-Tampering with KUKSA

VSS Model for Anti-Tampering Prototype

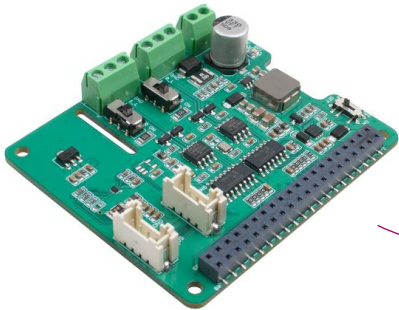


SCR Anti-Tampering with KUKSA

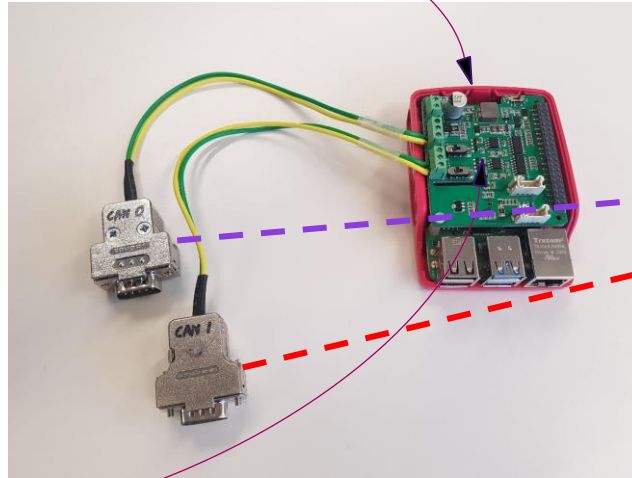
Connecting to the vehicle in our experiment



Raspberry Pi 4



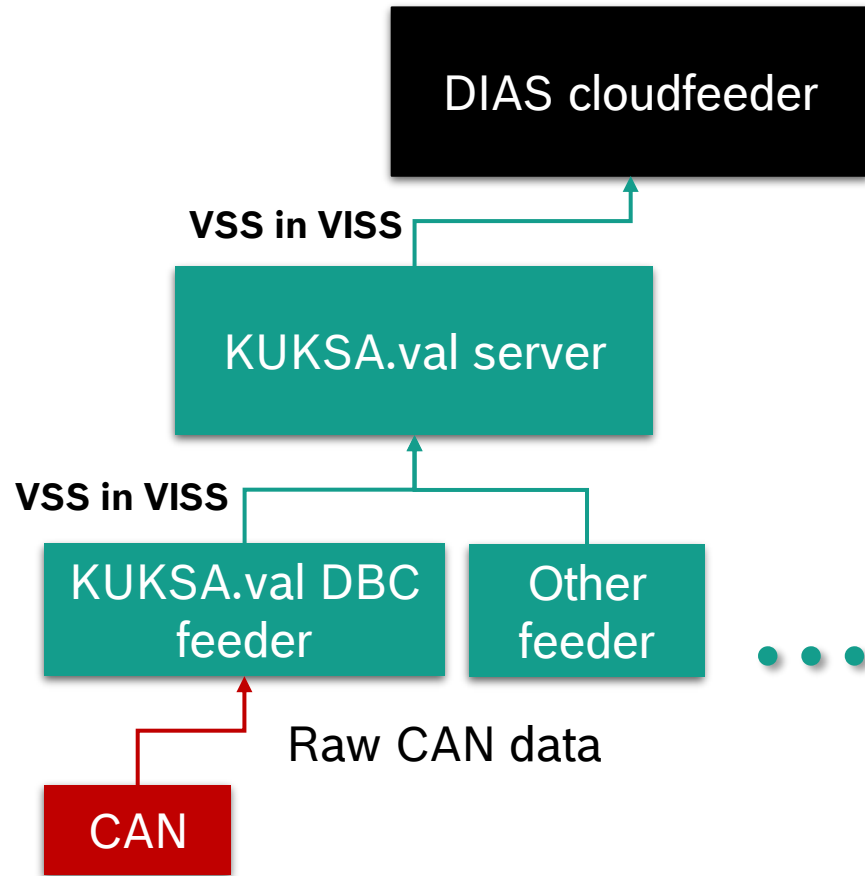
2-Channel CAN Shield
(Seed Studio)



Two CAN channels are used here because modern vehicles have several independent CAN buses and in our test vehicle the relevant signals are spread across two CAN buses

SCR Anti-Tampering with KUKSA

Accessing signals with KUKSA.val



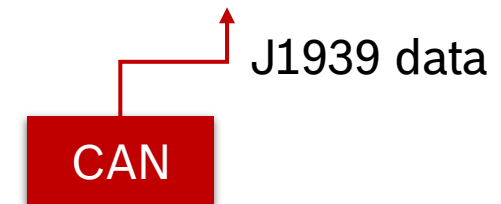
- Proprietary frames are read from CAN
- A KUKSA *feeder* component transforms them into a format described using the standardized Genivi VSS (Vehicle Signal Specification)
- The VSS datapoints are then transferred to the KUKSA.val server using the standardized W3C VISS (Vehicle Information Service Specification) protocol
- Applications can access the data via VISS



SCR Anti-Tampering with KUKSA

J1939 extension for KUKSA.val DBC Feeder (1)

- When starting, KUKSA.vals DBC feeder just supported raw CAN frames, as are commonly used in passenger vehicles
- Heavy duty vehicles such as trucks often use SAE-J1939
 - J1939 is still using CAN for transport
 - It adds a higher layer protocol, that – among other things – supports logic data frames larger than one CAN frame (8 bytes for classic CAN)
 - Signal locations based on “PGN” (Parameter Group Number) instead of CAN ID
 - Can be described in a DBC File

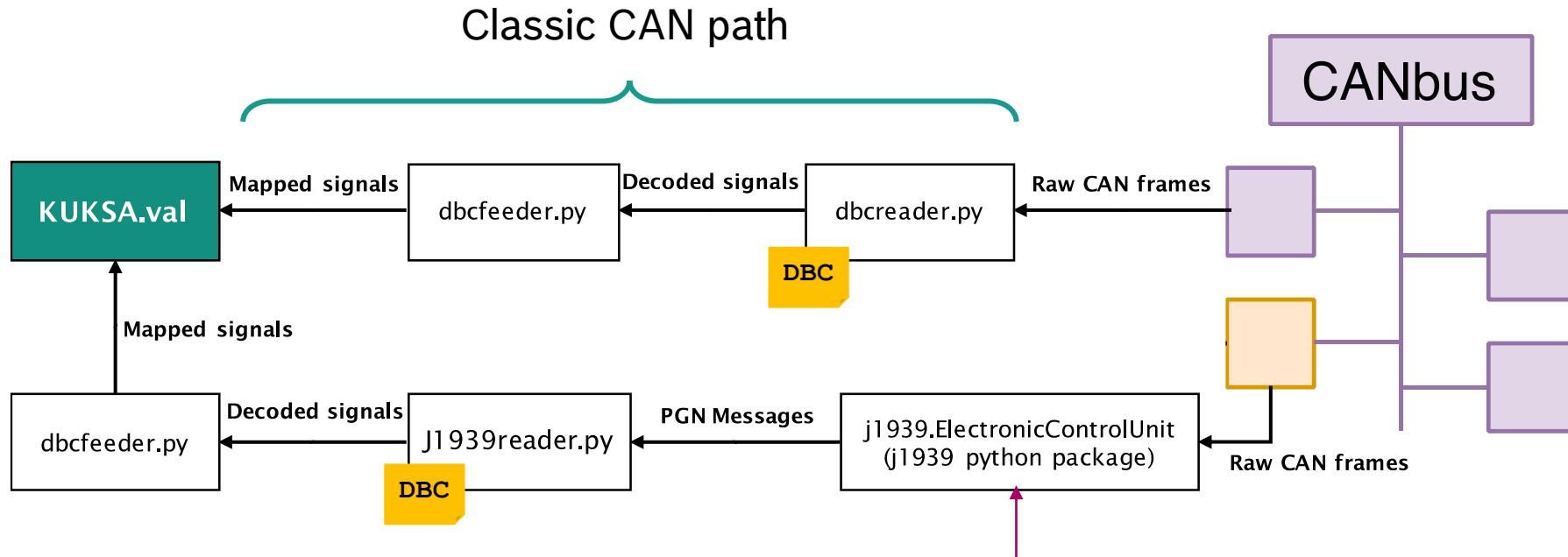


<https://www.sae.org/standardsdev/groundvehicle/j1939a.htm>

<https://www.csselectronics.com/screen/page/simple-intro-j1939-explained/language/en#j1939-pgn-spn>

SCR Anti-Tampering with KUKSA

J1939 extension for KUKSA.val DBC Feeder (2)



New J1939 path:

Mapping based on
J1939 DBC file

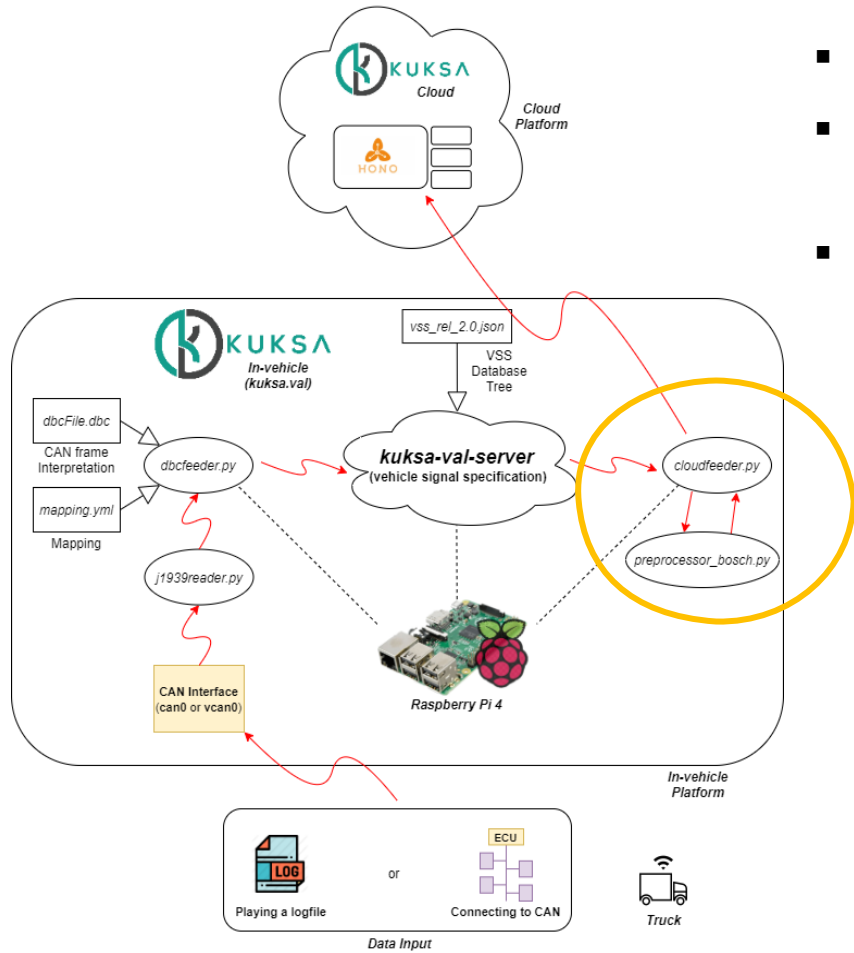
Can parse J1939 frames

**This has been contributed to KUKSA.val by the DIAS project and has been merged.
Everybody can use it now**

https://github.com/eclipse/kuksa.val/tree/master/kuksa_feeders/dbc2val

SCR Anti-Tampering with KUKSA

DIAS Cloud feeder



- Fetches required signals from *KUKSA.val* server
- Pre-processes the fetched signals' values with variable preprocessor script
- Sends the pre-processed result as telemetry data to the cloud via MQTT

Fetches signals

Pre-processed result telemetry

MQTT transmission

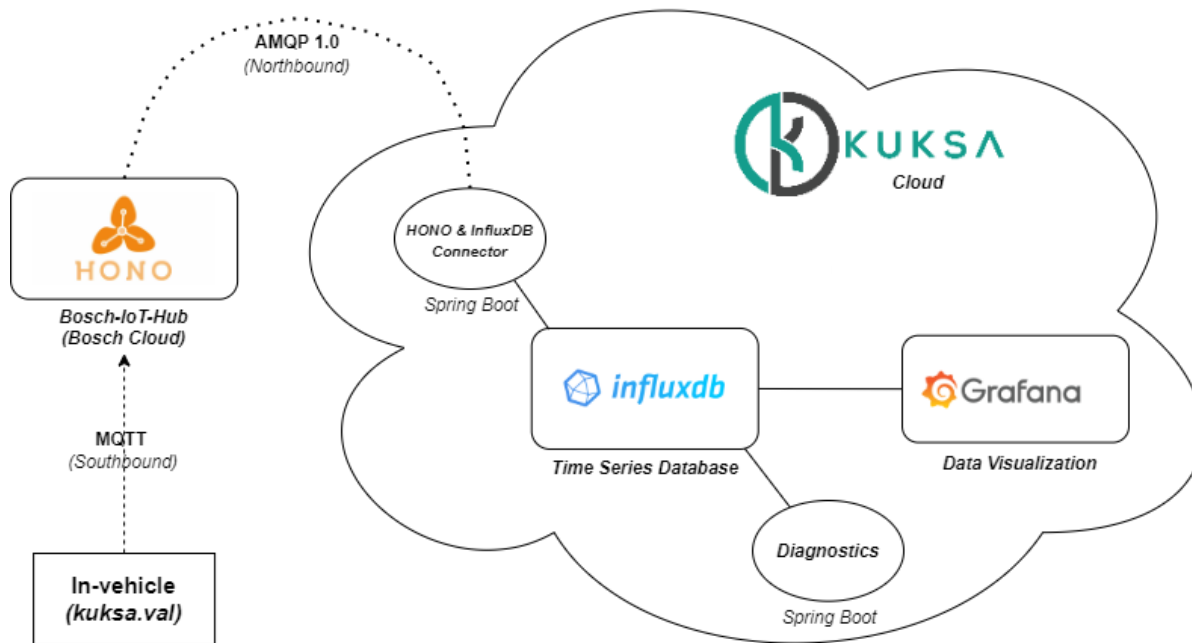
```

Junh-ki@junhki-VirtualBox: ~/Desktop/kuksa.val/clients/vss-testclient
File Edit View Search Terminal Help
##### Signals #####
Aftertrtmnt1SCRctlstIntkGasTemp : 220
Aftertrtmnt1IntakeNOx : 341.3999938964844
Aftertrtmnt1OutletNOx : 0
Aftertrtmnt1ExhaustGasMassFlow : 685.0
NominalFrictionPercentTorque : 6.0
AmbientAirTemp : 1.875
BarometricPress : 98.0
EngCoolantTemp : 84.0
EngPercentLoadAtCurrentSpeed : 75.0
EngReferenceTorque : 2705.0
EngSpeedAtPoint2 : 1800.0
EngSpeedAtIdlePoint1 : 550.0
EngSpeed : 1190.5
ActualEngPercentTorque : 52.0
TimeSinceEngineStart : 181
MalfunctionIndicatorLampStatus : 0
##### Telemetry #####
Telemetry: {'sampling_time': {'total_sampling': 17, 'tscr_bad': 1, 'tscr_intermediate': 0, 'tscr_good': 16, 'old_good': 0, 'pems_cold': 0, 'pems_hot': 16}, 'tscr_good': {'11': {'cumulativeNOxDS_g': 0.0, 'cumulativeNOxDS_ppm': 0, 'cumulativeNOxUS_g': 0.5005722954932131, 'cumulativeNOxUS_ppm': 1655.2999877929688, 'cumulativePower_J': 787976.3873304392, 'cumulativePower_kWh': 0.21888232981401085, 'samplingTime': 5}}, 'pems_hot': {'11': {'cumulativeNOxDS_g': 0.0, 'cumulativePower_J': 787976.3873304392, 'cumulativePower_kWh': 0.21888232981401085, 'samplingTime': 5}}}
# Socket Connected :)
# Current telemetry being sent...
Client mosqpub|13496-junhki-Vi sending CONNECT
Client mosqpub|13496-junhki-Vi received CONNACK
Client mosqpub|13496-junhki-Vi sending PUBLISH (d0, q0, r0, m1, 'telemetry', ... (557 bytes)
Client mosqpub|13496-junhki-Vi sending DISCONNECT
# Successfully done!
    
```

https://github.com/junh-ki/dias_kuksa/

SCR Anti-Tampering with KUKSA

KUKSA.cloud setup



- * AMQP (Advanced Message Queue Protocol)
- * MQTT (Message Queuing Telemetry Transport)

Bosch-IoT-Hub (Eclipse Hono)

- Remote service interfaces for connecting IoT devices in a uniform way

Hono-InfluxDB-Connector

Connects to Hono and InfluxDB, to receive and store data

InfluxDB

- Data are stored in chronological order

Grafana

- Visualizes data in InfluxDB

Diagnostics

- Evaluates data in InfluxDB

PUTTING IT ALL TOGETHER & FINAL THOUGHTS

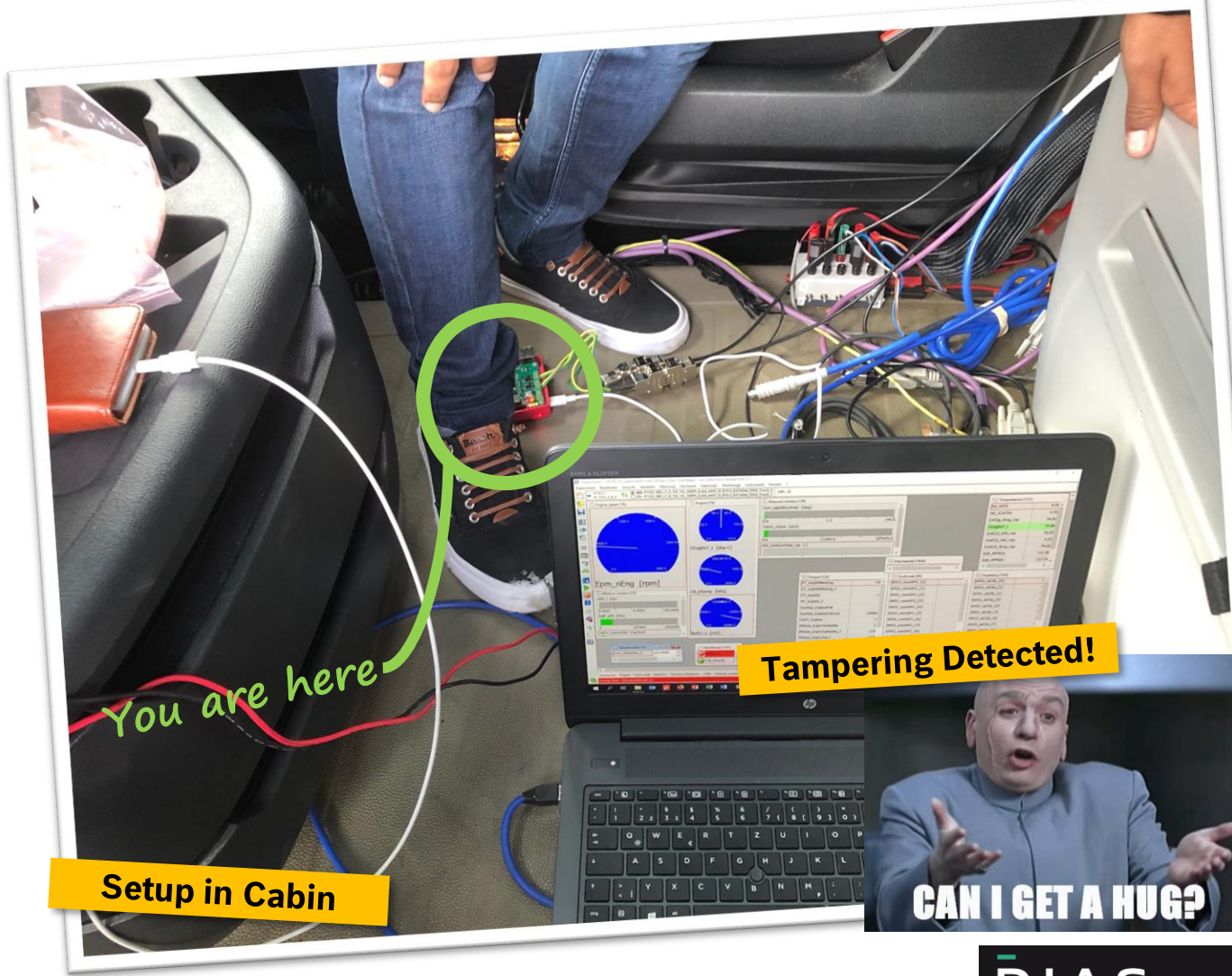
SCR Anti-Tampering with KUKSA Testing...



DIAS Test Vehicle

Progress	Evaluation Point	Evaluation Round		
6320	6320	Round: 1	Mode: (0=trac-bad, 1=trac-intermediates, 2=trac-good, 3=void-good, 4=perms-cold, 5=perms-hot): 2	
Average Evaluation Round	No Saved After Evaluation Result	Evaluation Result		
Tampering (1+Y / 0+N): 0	Tampering (1+Y / 0+N): 0	Tampering (1+Y / 0+N): 0		
Average Evaluation Status	Sec 3	Sec 10	Sec 11	Sec 12
Status (0=No Tampering / 1=Tampering / 2=Suspiciously Low): 0	Factor (-1=Void): 0.232	Factor (-1=Void): 0.381	Factor (-1=Void): 0.587	Factor (-1=Void): 0.751
Factor Average: 1.554	Factor (-1=Void): 0.686	Factor (-1=Void): 0.526	Factor (-1=Void): 0.886	Factor (-1=Void): 0.591
	Sec 1	Sec 2	Sec 4	Sec 5
	Factor (-1=Void): 0.912	Factor (-1=Void): 2.406	Factor (-1=Void): 7.193	

Grafana Dashboard



You are here

Setup in Cabin

Tampering Detected!



SCR Anti-Tampering with KUKSA

Open points and future work

- “Deepen” security:
 - Currently we need to “trust” data received from CAN bus, and detect tampering solely through inconsistency, plausibilisation
 - Mechanisms for authenticating data on CAN exist, but are not widely deployed yet. Would be a good first line of defence
- Limits of OSS approach
 - The proposed system, tested on a Pi can easily run on a modern (processor-based) Vehicle Computers. However, requires modern vehicles that offer suitable runtimes/sandboxes for modern software
 - The “deeper” you go, the more proprietary vehicle architectures get. Probably there will not be much OSS/open systems in the layers below Vehicle Computers
- Not all data used for this use case is specified in the standard VSS data catalogue (yet)

SCR Anti-Tampering with KUKSA

Learnings

- Building DIAS SCR Anti-Tampering system starting **from a vehicle bus to the cloud** is possible using only **Open Source** technologies
- Adapting existing solutions is much faster than starting from scratch for “non-core” topics such as
 - In-vehicle data server
 - Connectivity
 - Cloud infrastructure
- Some assembly required: Provided initial J1939 support back to Eclipse KUKSA, saving more time on the next use case
- No need to share application IP (detailed algorithm for detection) when using Eclipse KUKSA:
“Open base services as a solid foundation for a variety of competing products and services”



<https://www.dias-project.com>



<https://www.eclipse.org/kuksa/>



Andreas Hastall

Powertrain Solutions
Advanced Engineering
Engineering Legislation and OBD System

andreas.hastall@de.bosch.com

Robert Bosch GmbH,
Robert-Bosch-Platz 1
70839 Gerlingen-Schillerhöhe

<https://www.bosch-mobility-solutions.com/>



Dr.-Ing.
Sebastian Schildt

Corporate Sector Research and
Advanced Engineering
Communication and Network Technologies

sebastian.schildt@de.bosch.com

Robert Bosch GmbH,
Robert-Bosch-Campus 1
71272 Renningen

<https://www.bosch.com/research/>

QUESTIONS?

