

06.07.2023

Eclipse SDV Community Day

openMDM - Data Management for SDV



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KARAKUN

www.karakun.com



We are developing
software.

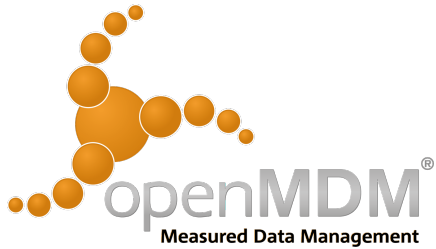
Custom Software Solutions

Digital Engineering Solutions

NLP & AI-based Text Analysis / Search



Open-Source Engagement



Member of Eclipse Working Group openMDM



Developer & maintainer of OpenWebStart



Supporting Member Eclipse Working Group Software Defined Vehicle

& many more ... WebTest, PillarOne, Open Dolphin, Rico, Groovy, Griffon, PreferencesFX, WorkbenchFX, ... - since 2000

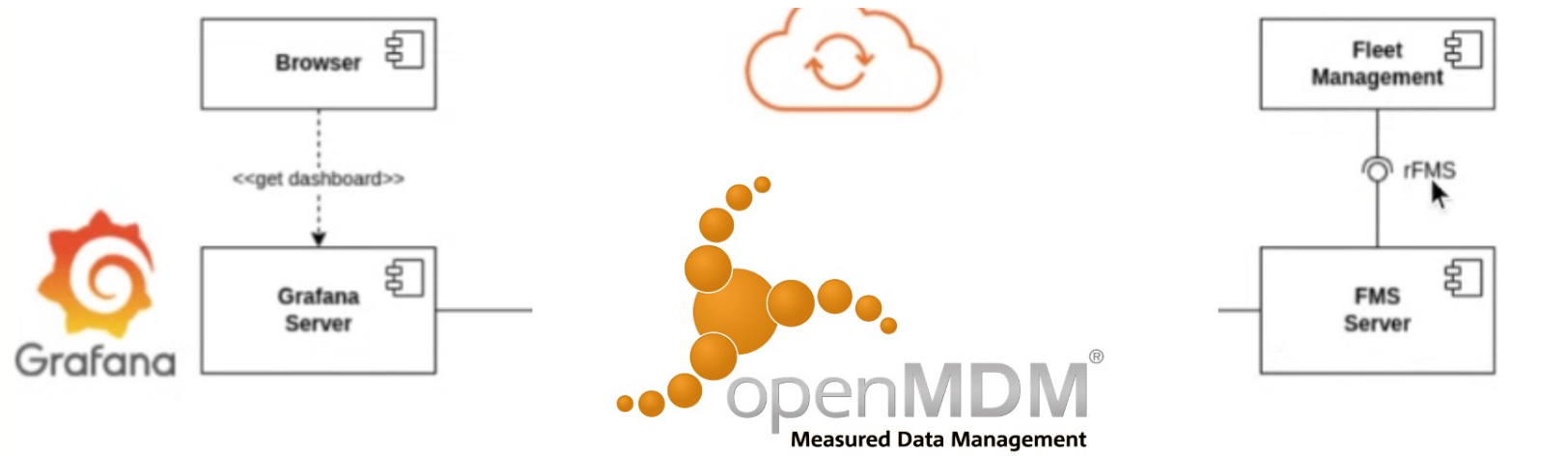
Why Data Management for SDV?

- Tons of data will be generated in-vehicle (during development / simulation / testing – operation)
- For validation / certification data must be managed (traceable, standardized)
- No vendor-specific technology

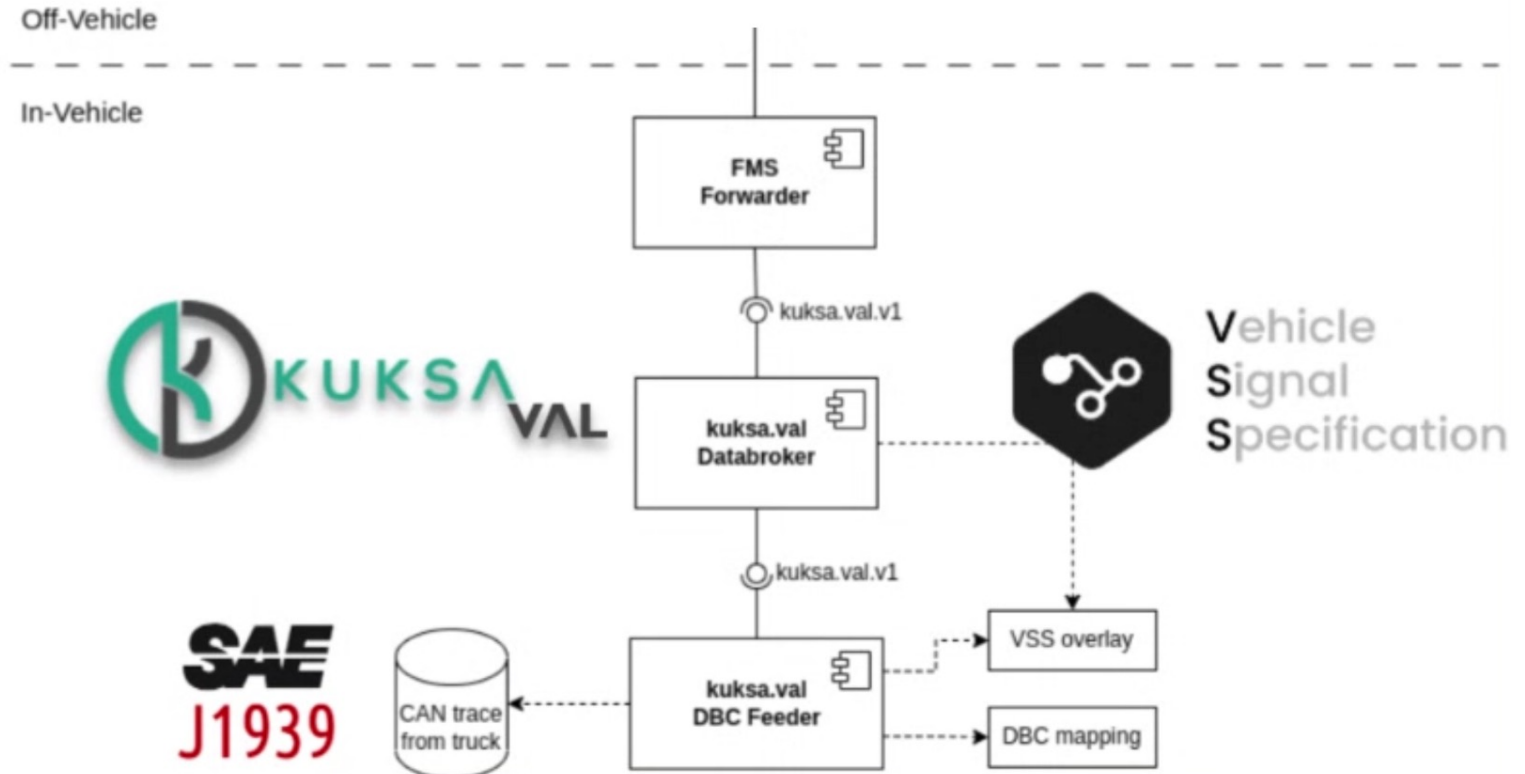


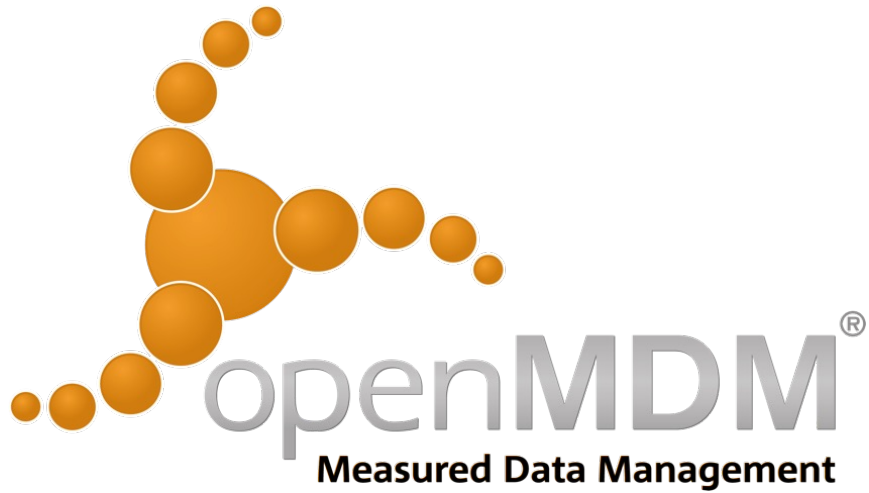
- Since about 10 years working in the area of (test) data management
- Active in the standard organisations ASAM, prostep ivip





openMDM is a good candidate to start with when it comes to off-vehicle data management





- openMDM is a working group (like SDV)
- Standardized test / measurement / simulation result data management
- Main focus on one Eclipse project: MDM|BL
<https://projects.eclipse.org/projects/automotive.mdmb1>
- Active since 2014

Our Members



MÜLLER-BBM
VibroAkustik Systeme

SIEMENS



<https://openmdm.org/>

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USP of openMDM

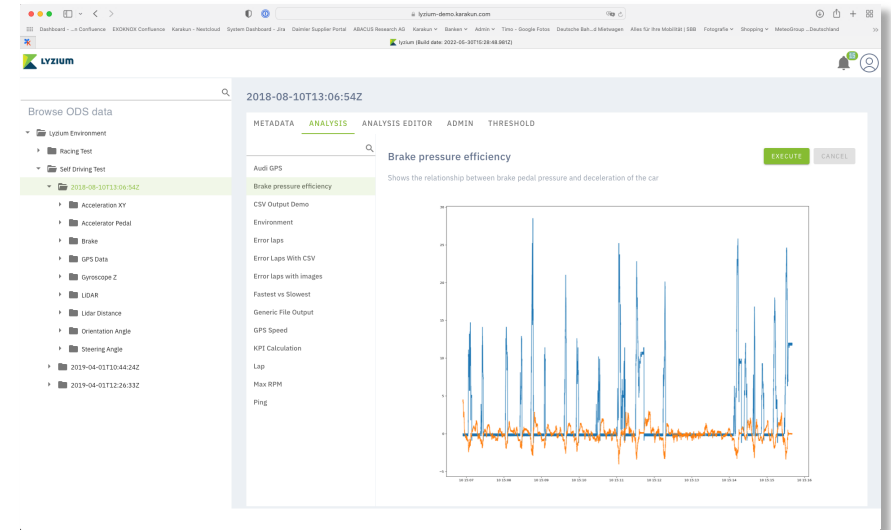
Allows engineers to manage multiple specific models of systems and their components as well as the evolution of the models together with various test configurations in one database



Introduction into openMDM data model

Integrated management of meta and mass data

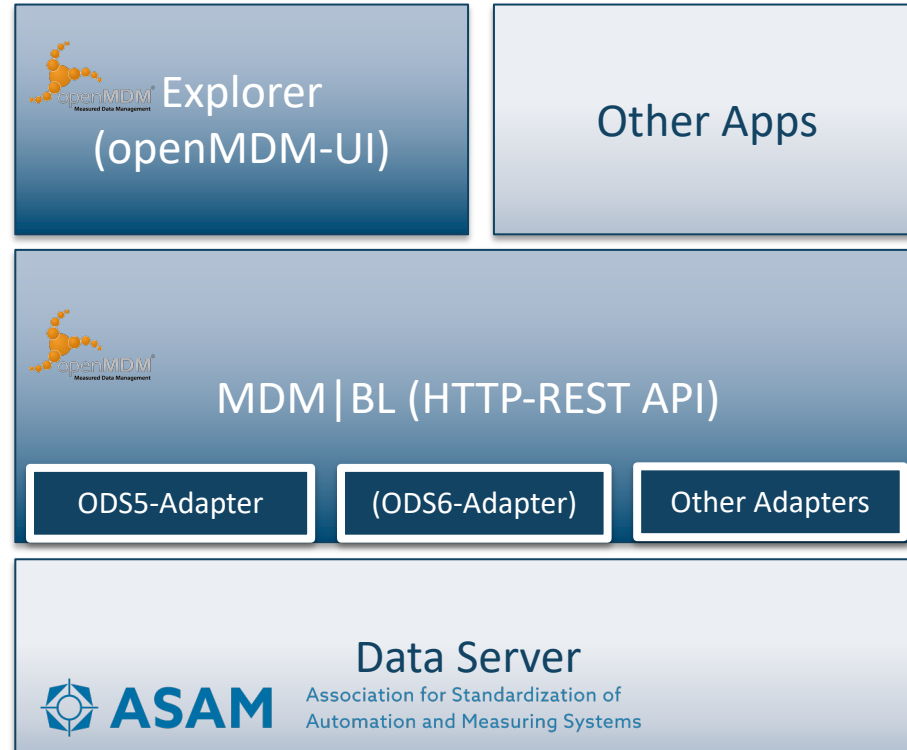
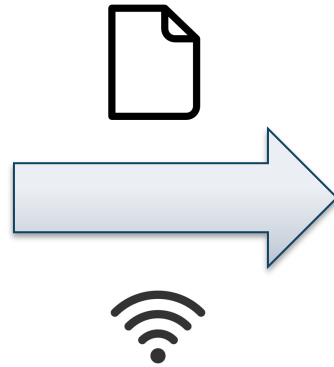
Demo



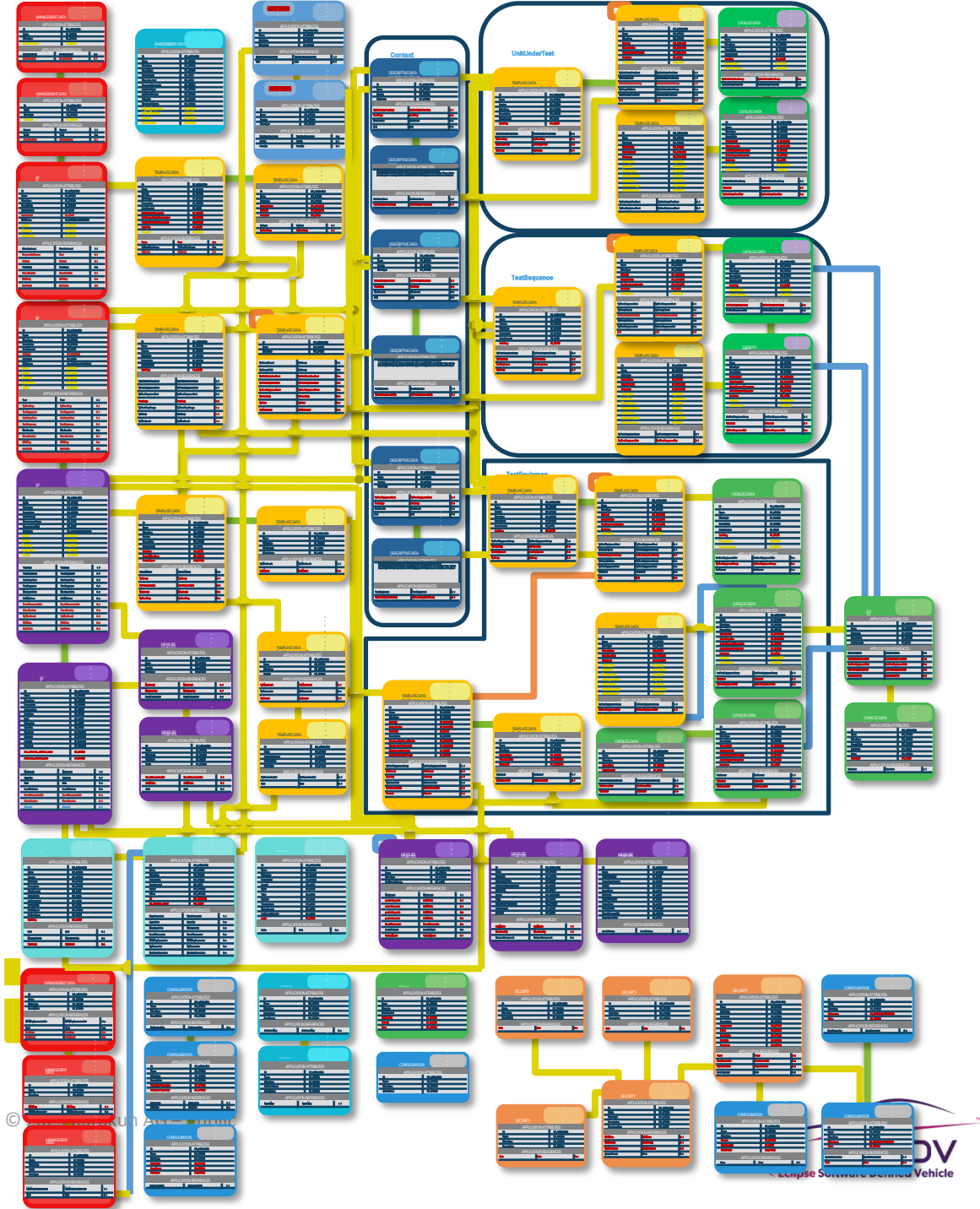
openMDM – High-Level Architecture



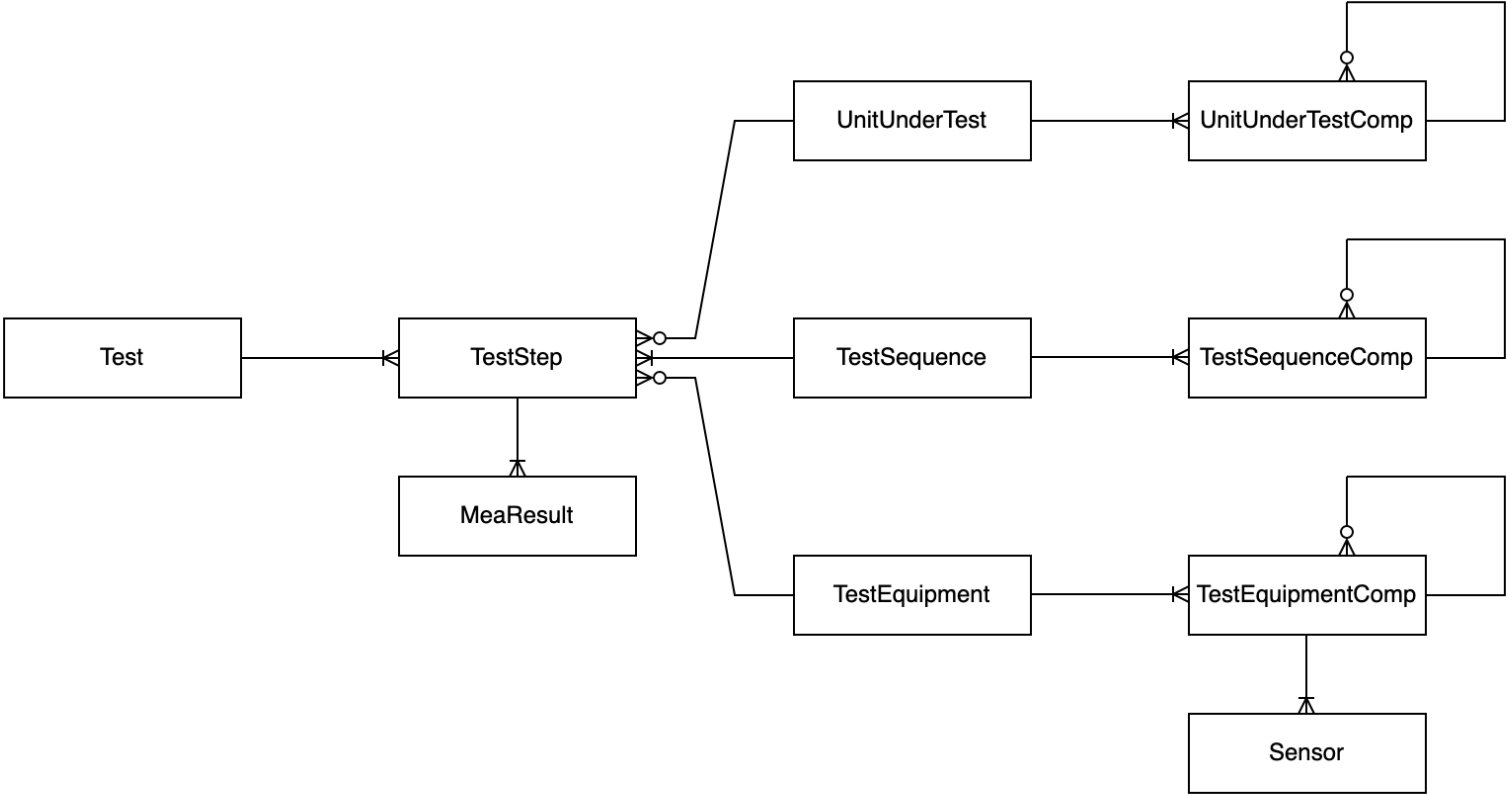
- test vehicles
- testbenches
- simulation tools



openMDM Data Model

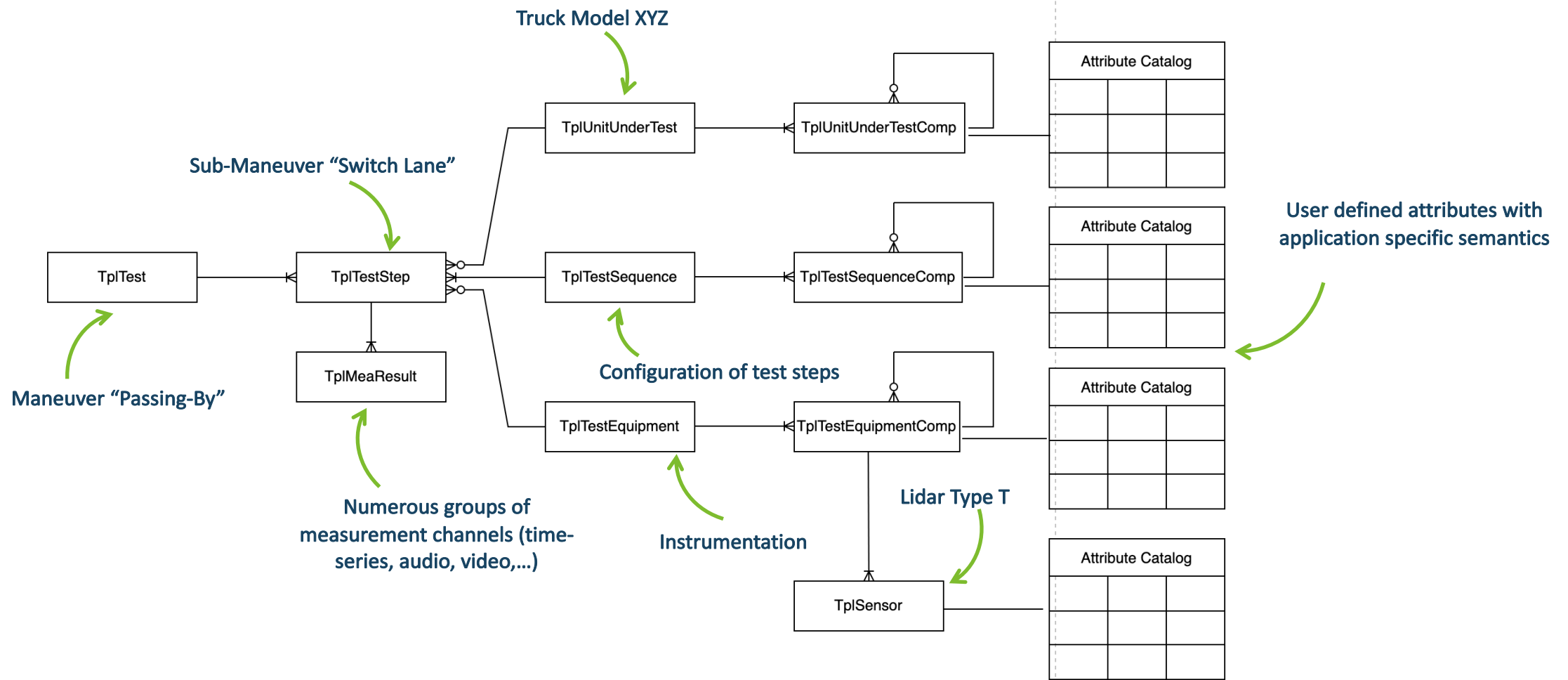


openMDM Data Model – Main Entities



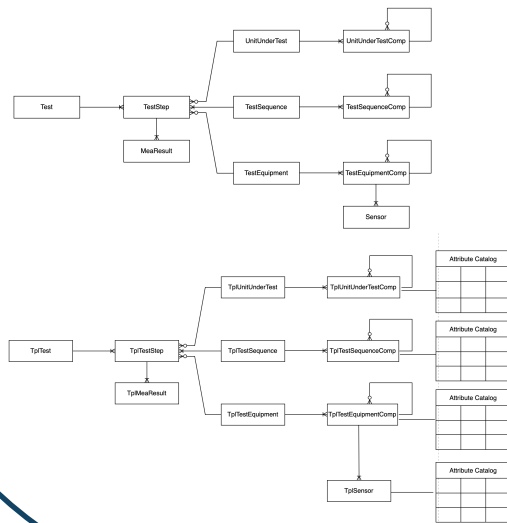
Predefined attributes with a defined semantics

Domain Specific Model by Templates

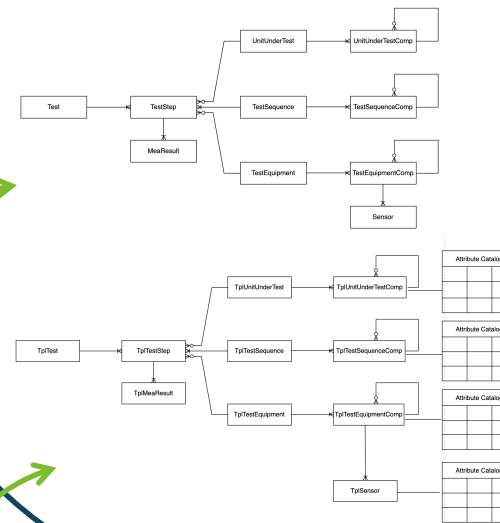


Managing Result Data

Maneuver «Passing-by»
with Lidar T
2023/07/06 10am



Maneuver «Passing-by»
with Lidar A
2023/07/09 12am



Generic and specific data

- Traceability with respect to
- evolution of models
 - configuration changes
 - test setup modifications

Version and configuration management allows to change all parts of the model without losing data consistency.

Demo

MDM Web Login

Navigator default ▾

- MDM

Details MDM Search QuickViewer X/Y-ChartViewer Files

Search filter **Source** **Result type**

Kein Filter ausgewählt MDM Test

Enter search text Search

Advanced search + [edit] [save] [close] [refresh] [clear] [dropdown]

No search attributes selected.

Results Standard ▾ + [edit] [save] [close] [dropdown]

Name (Test) ⇅

No records found.

1 10 ▾

Shopping basket Standard ▾ + [edit] [save] [close] [refresh] [clear] [dropdown]

Navigator default

- MDM
 - Running Project
 - Self Driving Project
 - Structure
 - Test
 - Test Step
 - 2018-08-10T13:06:54Z
 - 2019-04-01T10:44:24Z
 - 2019-04-01T12:26:33Z

Details MDM Search QuickViewer X/Y-ChartViewer Files

Search filter **Source** **Result type**

Kein Filter ausgewählt MDM Test

Enter search text Search

Advanced search + [edit] [save] [close]

No search attributes selected.

Results Standard + [edit] [save] [close] 0 [edit] [trash] [dropdown]

Name (Test) [dropdown]

No records found.

1 10

Shopping basket Standard + [edit] [save] [close] [edit] [refresh] [dropdown] [edit] [save] [trash] [dropdown]

Navigator default

- MDM
 - Racing Project
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 - Structure
 - Test
 - Test Step
 - 2018-08-10T13:06:54Z
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 - 2019-04-01T12:26:33Z

Details MDM Search QuickViewer X/Y-ChartViewer Files

General Unit under test Test sequence Test equipment Sensors

Measurement result

Attribute	Value	Unit
Description		
File attachments	No files attached	
Measurement end		
Created	2022-10-10T18:04:50Z	
Analytic Path	1 file attached	
Mimetype	application/x-asam.aomeasurement	
Measurement begin		
Name	2019-04-01T12:26:33Z	

Shopping basket Standard + [edit] [save] [close]

[edit] [refresh] [dropdown] [refresh] [save] [close] [next]

Navigator default

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 - 2019-04-01T10:44:24Z
 - 2019-04-01T12:26:33Z

Details MDM Search QuickViewer X/Y-ChartViewer Files

General **Unit under test** Test sequence Test equipment Sensors

Name	Ordered	Measured
Vehicle		
Maximum Torque	22 Nm	22 Nm
Vehicle Make	Audi	Audi
Top speed	230 km/h	230 km/h
Gear Shift	automatic	automatic
Conventional Engine	3.0 TDI V6	3.0 TDI V6
Vehicle Model	Q7 e-tron TDI Quattro	Q7 e-tron TDI Quattro
Gears	6	6
Power elec.	94 kW	94 kW
Drive	4x4	4x4
Acceleration	6.2 s	6.2 s
CO2 Emission	50 g/km	50 g/km
Acceleration elec. (0-60km/h)	6.5 s	6.5 s
Power	190 kW	190 kW
Fuel Consumption	1.9 l/100km	1.9 l/100km
Range elec.	56 km	56 km
Top Speed elec.	135 km/h	135 km/h

Shopping basket Standard + [edit] [print] [close] [refresh] [stop] [back] [forward] [home]

Navigator default ▾

- MDM
 - ▶ Racing Project
 - ▶ Self Driving Project
 - ▶ Structure
 - ▶ Test
 - ▶ Test Step
 - ▶ 2018-08-10T13:06:54Z
 - ▶ 2019-04-01T10:44:24Z
 - ▶ 2019-04-01T12:26:33Z

Details MDM Suche QuickViewer X/Y-ChartViewer Dokumente

General Prüfling Testablauf **Messgerät** Sensoren

Name	Beauftragt	Gemessen
> Kamera (vorne mitte)		
> Kamera (vorne links)		
> Kamera (vorne rechts)		
> Kamera (hinten mitte)		
> Kamera (seite links)		
▼ Kamera (seite rechts)		
Kameramodell	Sekonix SF3324-100	Sekonix SF3324-100
Farbfilteranordnung	RCCB	RCCB
Diagonales Sichtfeld	146°	146°
Bildrate	30 fps	30 fps
Horizontales Sichtfeld	120°	120°
Position	side-right	side-right
Auflösung	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertikales Sichtfeld	73°	73°
▼ LiDAR (vorne mitte)		
Genauigkeit	3 cm	3 cm
Azimutalesichtfeld	360°	360°
Kanäle	16	16
LiDAR Modell	VLP-16	VLP-16
Maximum Reichweite	100 m	100 m
Rate	300'000 points/s	300'000 points/s
Rotationsrate	10 Hz	10 Hz
Vertikalesichtfeld	30°	30°
Vertikale Auflösung	2°	2°
Position	front-center	front-center
> LiDAR (vorne links)		
> LiDAR (vorne rechts)		
> LiDAR (hinten links)		
> LiDAR (hinten rechts)		

Warenkorb Standard ▾ + ✎ 📄 ✕ ✎ ⏪ ▾ ⏩ 📄 ➡

Navigator default

- MDM
 - Racing Project
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 - Structure
 - Test
 - Test Step
 - 2018-08-10T12:06:54Z
 - 2019-04-01T10:44:24Z
 - 2019-04-01T12:26:33Z
 - Acceleration XY
 - Accelerator Pedal
 - Brake
 - GPS Data
 - Gyroscope Z
 - LIDAR
 - Lidar Distance
 - Orientation Angle
 - Steering Angle

Details MDM Search QuickViewer X/Y-ChartViewer Files

General Unit under test Test sequence Test equipment Sensors

Name	Ordered	Measured
Front-center camera		
Camera Model	Sekonix SF3325-100	Sekonix SF3325-100
Color Filter Array	RCCB	RCCB
Diagonal Field of View	70°	70°
Framerate	30 fps	30 fps
Horizontal Field of View	60°	60°
Location	front-center	front-center
Resolution	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertical Field of View	38°	38°
Front-left camera		
Camera Model	Sekonix SF3324-100	Sekonix SF3324-100
Color Filter Array	RCCB	RCCB
Diagonal Field of View	146°	146°
Framerate	30 fps	30 fps
Horizontal Field of View	120°	120°
Location	front-left	front-left
Resolution	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertical Field of View	73°	73°
Front-right camera		
Camera Model	Sekonix SF3324-100	Sekonix SF3324-100
Color Filter Array	RCCB	RCCB
Diagonal Field of View	146°	146°
Framerate	30 fps	30 fps
Horizontal Field of View	120°	120°
Location	front-right	front-right
Resolution	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertical Field of View	73°	73°
Rear-center camera		
Camera Model	Sekonix SF3324-100	Sekonix SF3324-100
Color Filter Array	RCCB	RCCB
Diagonal Field of View	146°	146°
Framerate	30 fps	30 fps
Horizontal Field of View	120°	120°
Location	rear-center	rear-center
Resolution	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertical Field of View	73°	73°
Side-left camera		
Camera Model	Sekonix SF3324-100	Sekonix SF3324-100
Color Filter Array	RCCB	RCCB
Diagonal Field of View	146°	146°
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 - Acceleration XY
 - acceleration_x
 - acceleration_y
 - angular_velocity_omega_x
 - angular_velocity_omega_y
 - timestamp
 - Accelerator Pedal
 - accelerator_pedal
 - accelerator_pedal_gradient_sign
 - timestamp
 - Brake
 - brake_pressure
 - timestamp
 - GPS Data
 - latitude_degree
 - latitude_direction
 - longitude_degree
 - longitude_direction
 - timestamp
 - Gyroscope Z
 - acceleration_z
 - angular_velocity_omega_z
 - timestamp
 - LiDAR
 - azimuth
 - col
 - depth
 - distance
 - lidar_id
 - point_x
 - point_y
 - point_z
 - reflectance
 - row
 - timestamp
 - Lidar Distance
 - distance_pulse_front_left
 - distance_pulse_front_right
 - distance_pulse_rear_left
 - distance_pulse_rear_right
 - timestamp

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Color Filter Array	RCCB	RCCB
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Framerate	30 fps	30 fps
Horizontal Field of View	120°	120°
Location	rear-center	rear-center
Resolution	1928 × 1208	1928 × 1208
Sensor	Onsemi AR0231	Onsemi AR0231
Vertical Field of View	73°	73°
Side-left camera		
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Color Filter Array	RCCB	RCCB
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Horizontal Field of View	120°	120°
Location	side-left	side-left
Resolution	1928 × 1208	1928 × 1208

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 - timestamp
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 - longitude_degree
 - longitude_direction
 - timestamp
 - Gyroscope Z
 - acceleration_z
 - angular_velocity_omega_z
 - timestamp
 - LIDAR
 - azimuth
 - col
 - depth
 - distance
 - lidar_id
 - point_x
 - point_y
 - point_z
 - reflectance
 - row
 - timestamp
 - Lidar Distance
 - distance_pulse_front_left
 - distance_pulse_front_right
 - distance_pulse_rear_left
 - distance_pulse_rear_right
 - timestamp

Details MDM Search QuickViewer **X/Y-ChartViewer** Files

Chart Table [Icons] 1 [Icons]

ChannelGroup ▾

- Filter ▾
- Acceleration XY
- Accelerator Pedal
- Brake

Y-Channel ▾

- Filter ▾

X-Channel ▸

No data

> Options

Shopping basket Standard ▾ [Icons]

Navigator default ▾

- MDM
 - Racing Project
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Details MDM Suche QuickViewer X/Y-ChartViewer Dokumente

Grafik Tabelle 1 0

ChannelGroup ▾

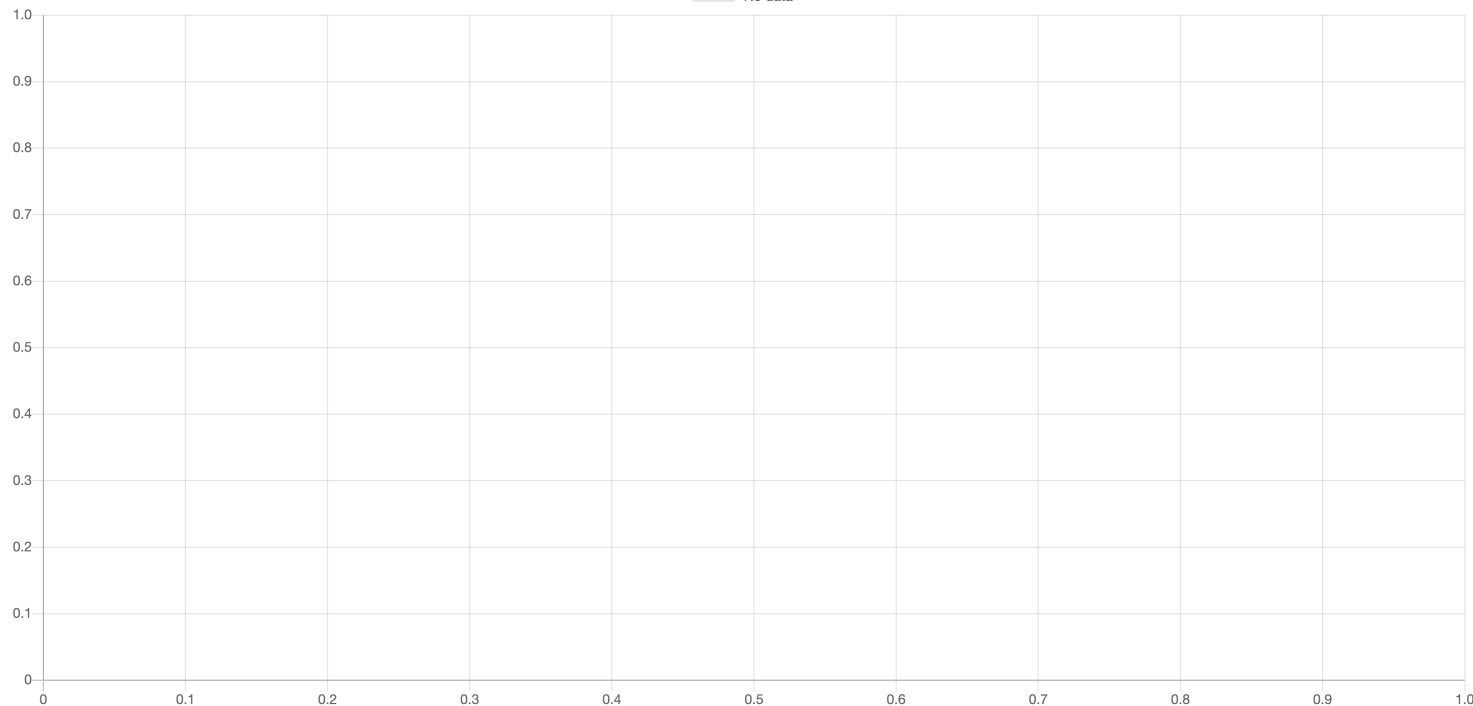
- Filter
- Acceleration XY
- Accelerator Pedal
- Brake

Y-Channel ▾

- Filter
- acceleration_x
- acceleration_y
- angular_velocity_omega_x
- angular_velocity_omega_y

X-Channel ▸

> Optionen



Warenkorb Standard ▾

Navigator default

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 - Lidar Distance
 - distance_pulse_front_left
 - distance_pulse_front_right
 - distance_pulse_rear_left
 - distance_pulse_rear_right
 - timestamp

Details MDM Search QuickViewer X/Y-ChartViewer Files

Chart Table [Icons] 1 [Zoom]

ChannelGroup

- Filter
- Acceleration XY
 - Accelerator Pedal
 - Brake

Y-Channel

- Filter
- acceleration_x
- acceleration_y
- angular_velocity_omega_x
- angular_velocity_omega_y

X-Channel >

> Options



Shopping basket Standard + [Icons]

[Icons]

Applications with openMDM



- NVH Test Applications
- Crash-Test Applications
- QA Applications for E-Engines
- Parameter-Database / Function-Data Management
- Big-Data Analytics Environment



Why openMDM for off-car data management?

- It is open source and based on a standard -> no vendor lock-in, interoperable
- Engineers can create specific models for their products as well as the test environment
- Traceability of model changes and result data history
- It exists! Proven in production at various organizations



Test installation can be provided

Thank you!



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