

An Evolving Ontology for Vehicle Signals

Daniel Wilms, BMW Technology Office Israel
Daniel Alvarez Coello, BMW Research, New Technologies, Innovations
Adnan Bekan, BMW Research, New Technologies, Innovations

DATA CENTRIC AS AN ANSWER TO INCREASING COMPLEXITY

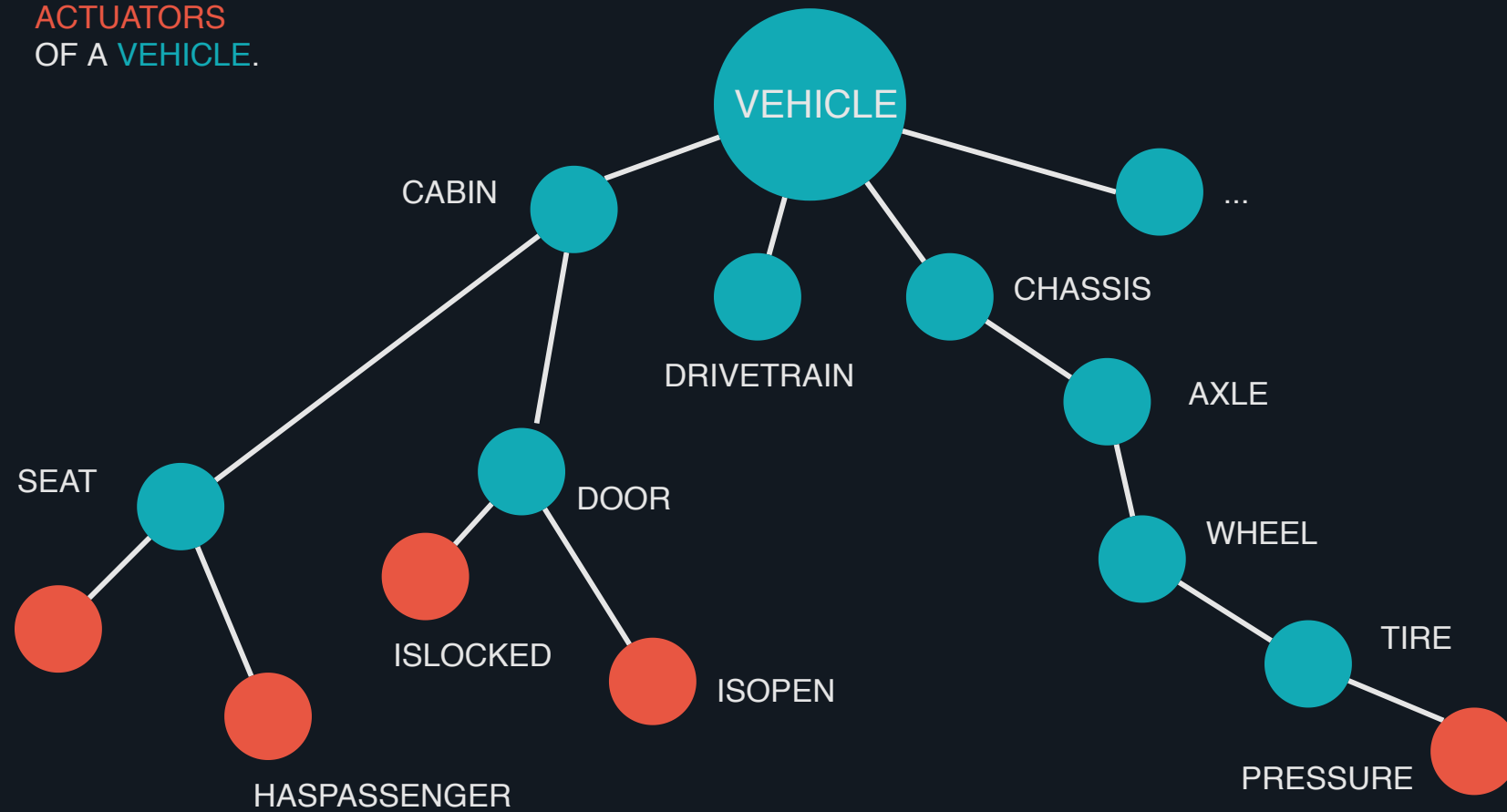
A good data-centric architecture is designed with **data sharing** in mind.

The **data model** is **permanent** and **enduring**, and applications come and go.

It's not something you **BUY**, it's something you **DO**!

VEHICLE SIGNAL SPECIFICATION (VSS)

TAXONOMY
FOR
ATTRIBUTES,
SENSORS AND
ACTUATORS
OF A VEHICLE.



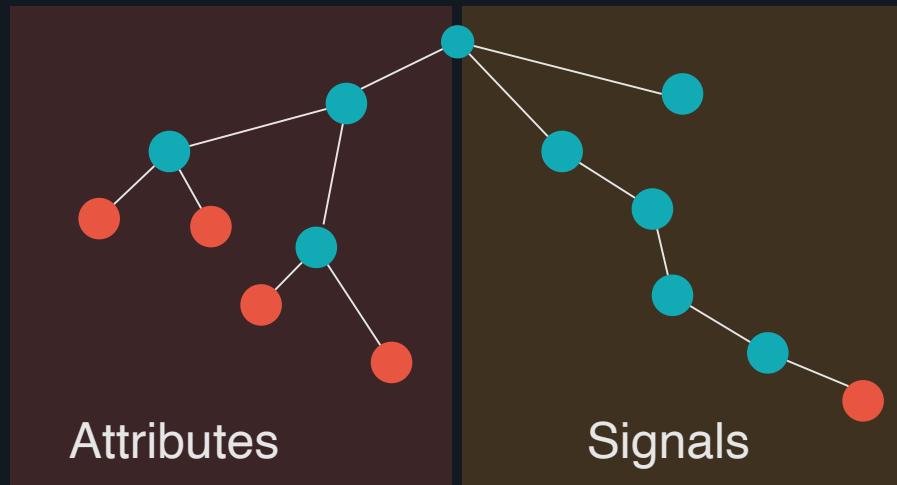
Vehicle Signal Specification as corner stone for Data Centric Architecture with regard to Vehicle Signals.

```
Vehicle.Drivetrain.Transmission.Speed
type: sensor
datatype: float
unit: km/h
description: The vehicle speed as measured by the drivetrain
```

YAML SPECIFICATION



VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSS_o)



VSS

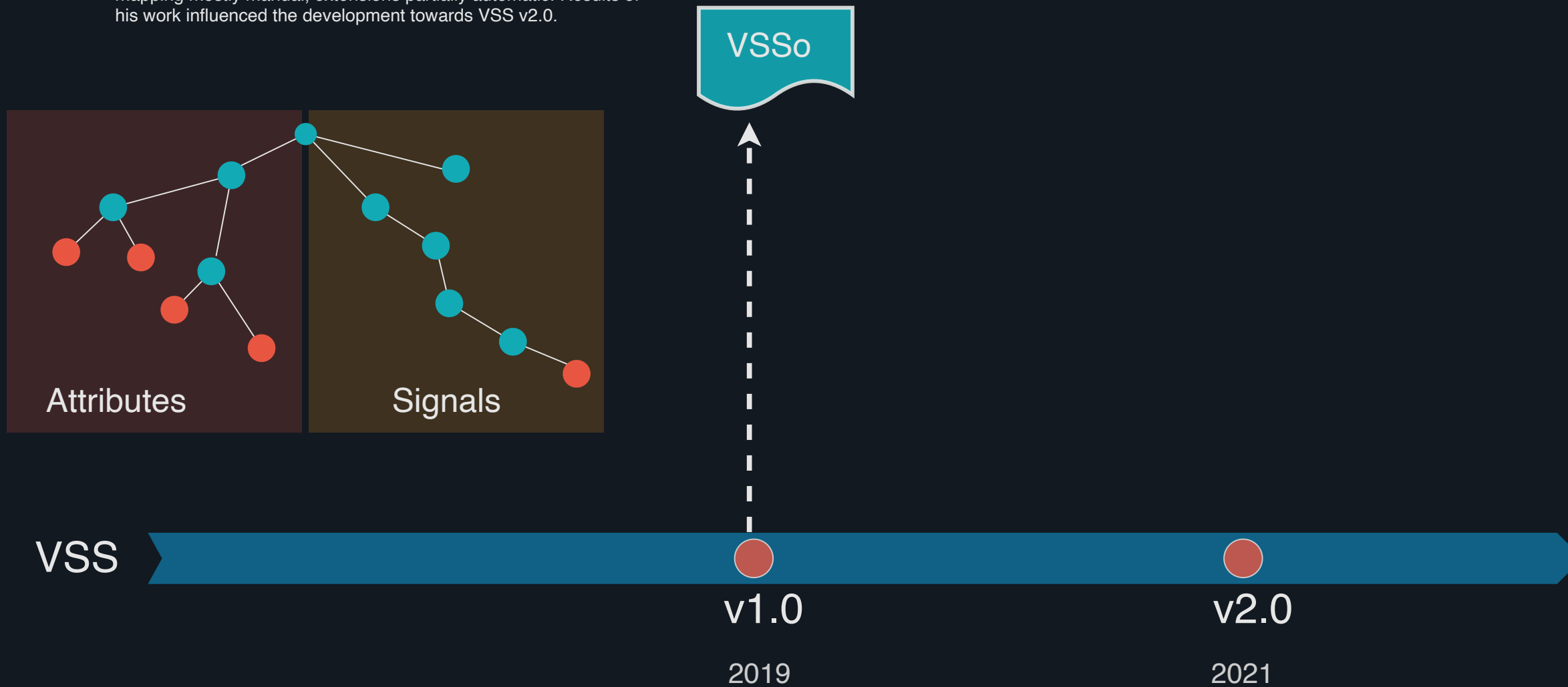
v1.0

2019

VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Initial VSSo Development

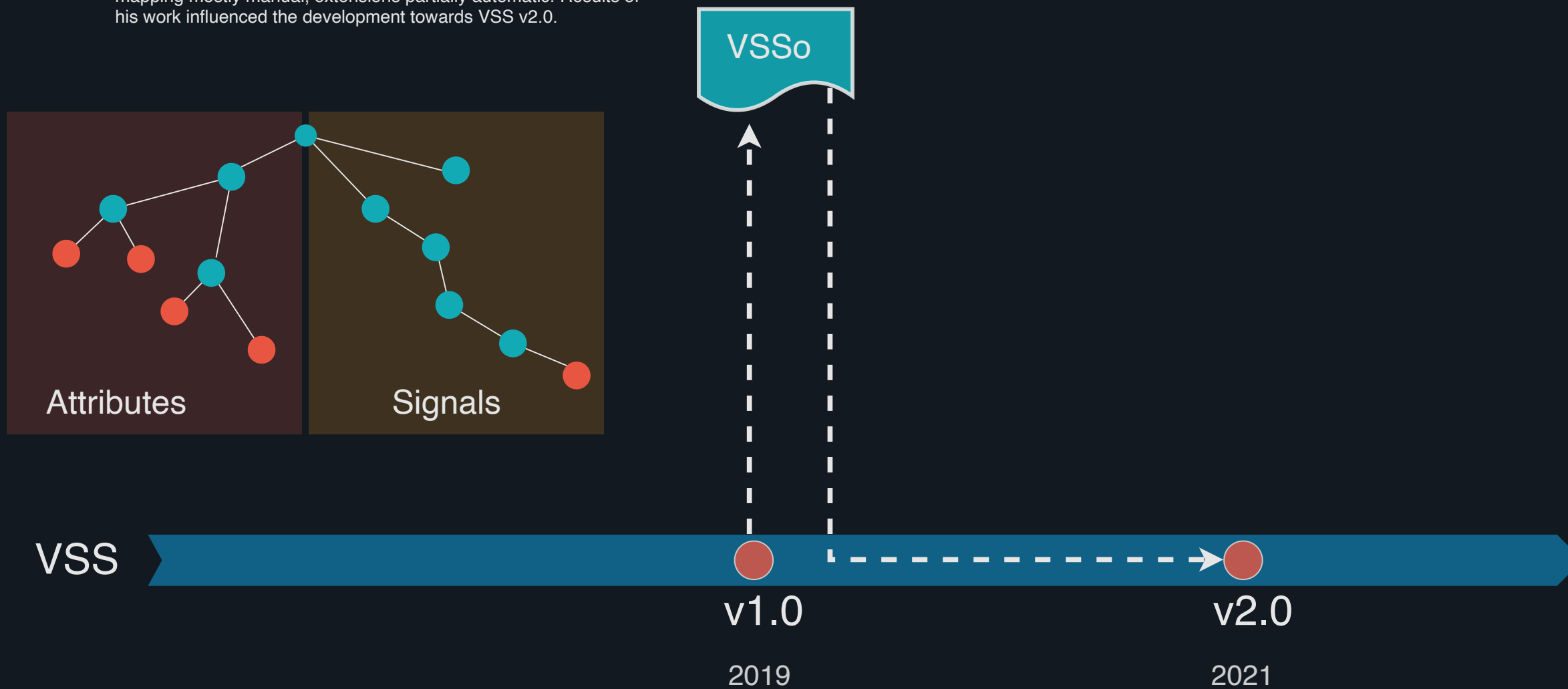
Based on VSS v1.0 Benjamin Klotz created within his PhD the first version of VSSo backed by Eurescom and BMW. Creation and mapping mostly manual, extensions partially automatic. Results of his work influenced the development towards VSS v2.0.



VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Initial VSSo Development

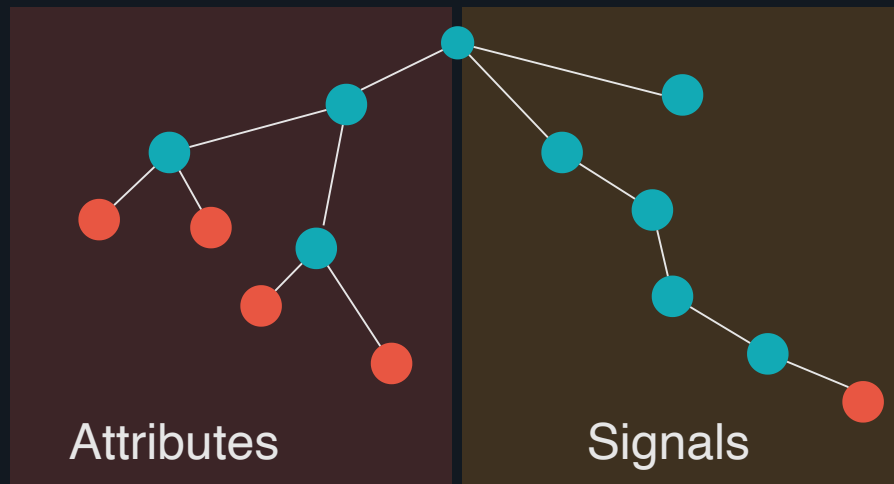
Based on VSS v1.0 Benjamin Klotz created within his PhD the first version of VSSo backed by Eurescom and BMW. Creation and mapping mostly manual, extensions partially automatic. Results of his work influenced the development towards VSS v2.0.



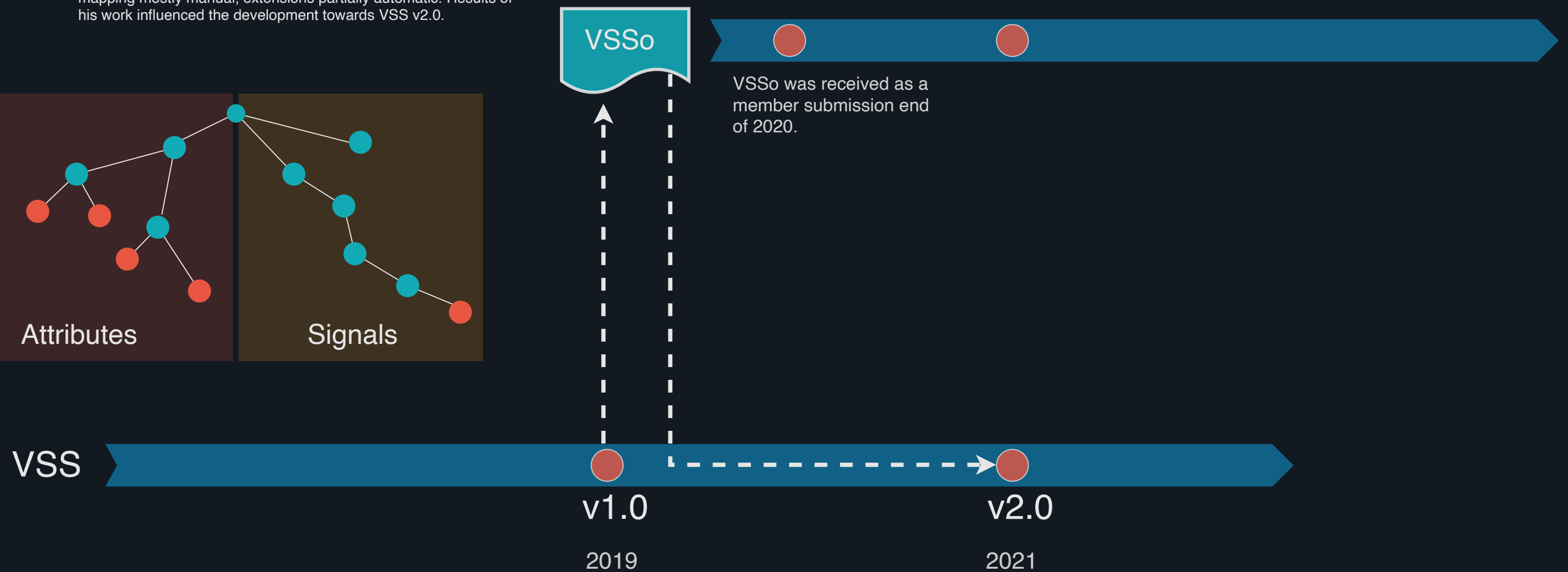
VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Initial VSSo Development

Based on VSS v1.0 Benjamin Klotz created within his PhD the first version of VSSo backed by Eureka and BMW. Creation and mapping mostly manual, extensions partially automatic. Results of his work influenced the development towards VSS v2.0.



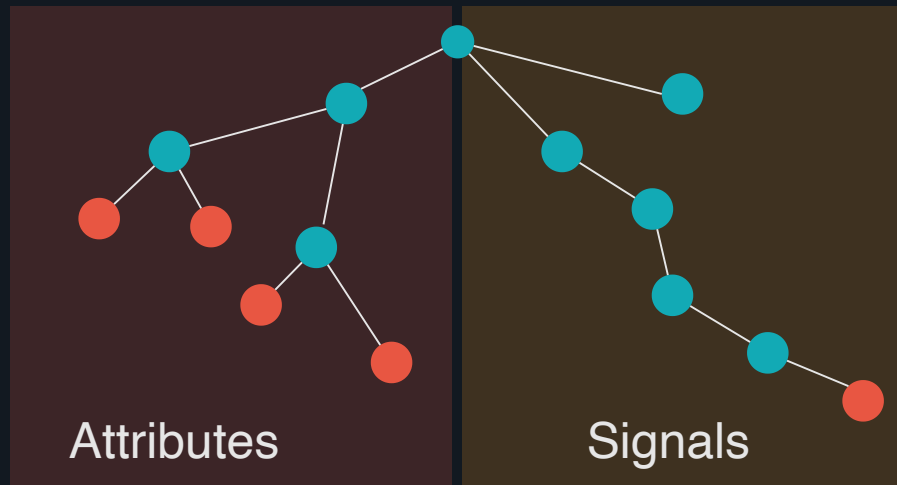
The W3C Automotive and Transportation Business Group has begun working on it.



VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Initial VSSo Development

Based on VSS v1.0 Benjamin Klotz created within his PhD the first version of VSSo backed by Eureka and BMW. Creation and mapping mostly manual, extensions partially automatic. Results of his work influenced the development towards VSS v2.0.



VSS

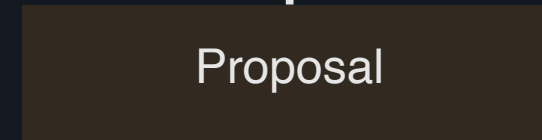


VSSo was received as a member submission end of 2020.

The W3C Automotive and Transportation Business Group has begun working on it.

VSSo is listed as a deliverable on W3C Recommendation track for the Automotive Working Group's proposed recharter

First public working draft released



v1.0

2019

v2.0

2021



<https://github.com/w3c/vsso>

QUESTION: How can current approaches to create a lean and consistent Vehicle Signal Ontology be adapted with a broader set of use cases?

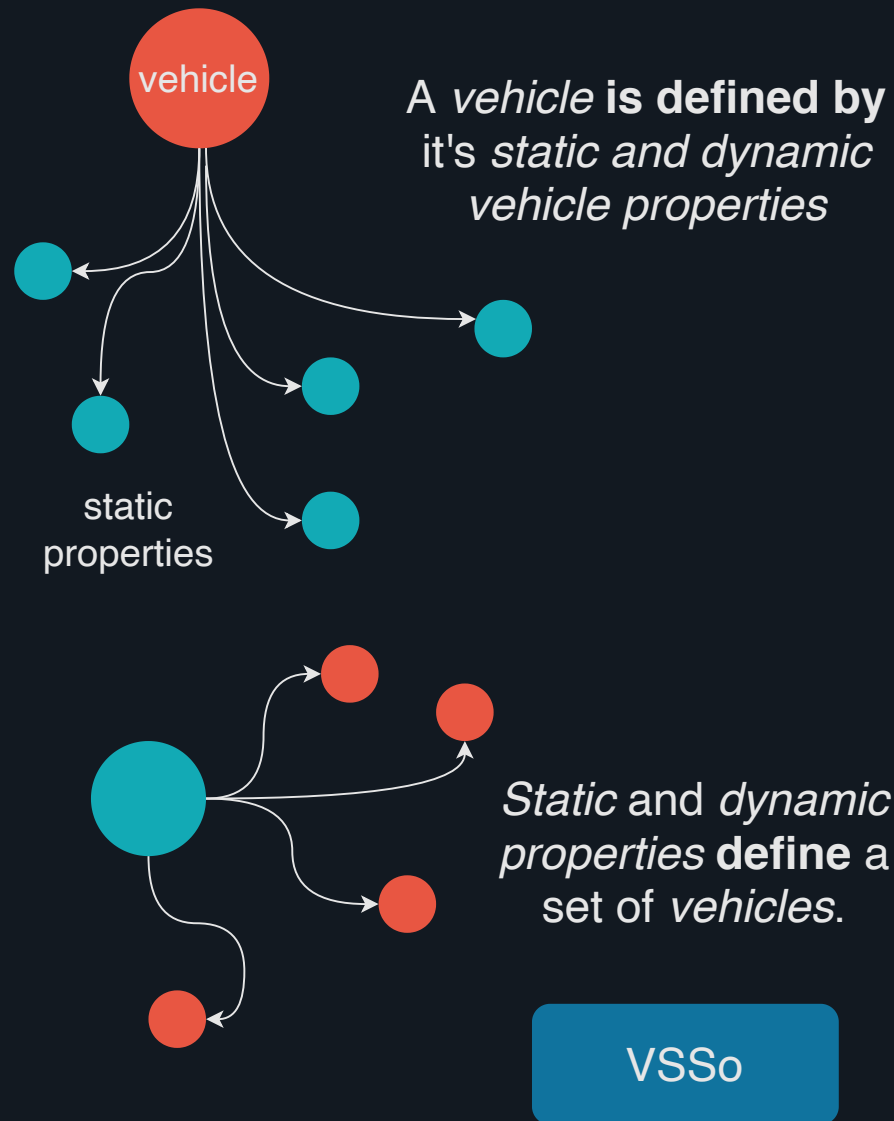
CONTRIBUTION:

- Create use case cluster
- Define extensible core ontology
- Automation through tooling

ANALYTICS

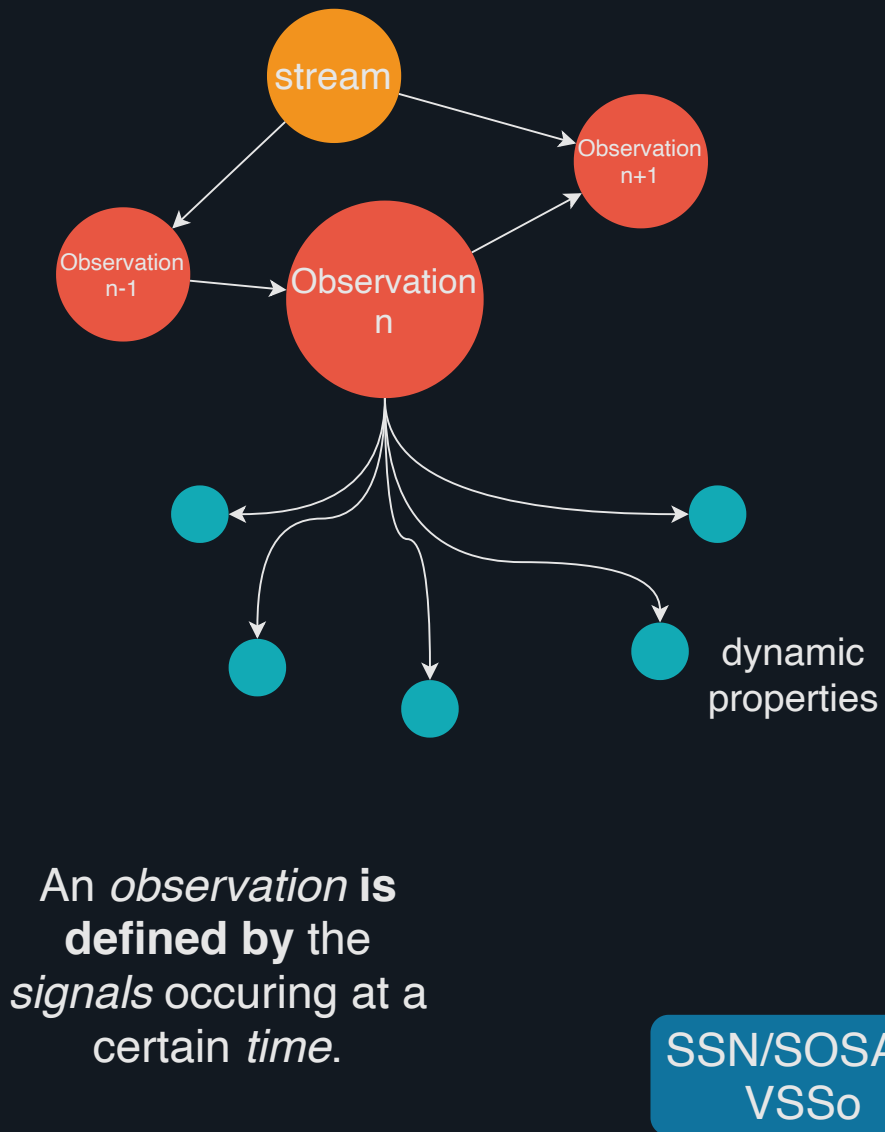
Current Vehicle Data

Find out what state a specific vehicle is in and how values of static and dynamic properties define a vehicle fleet.



Dynamic Vehicle Data over Time

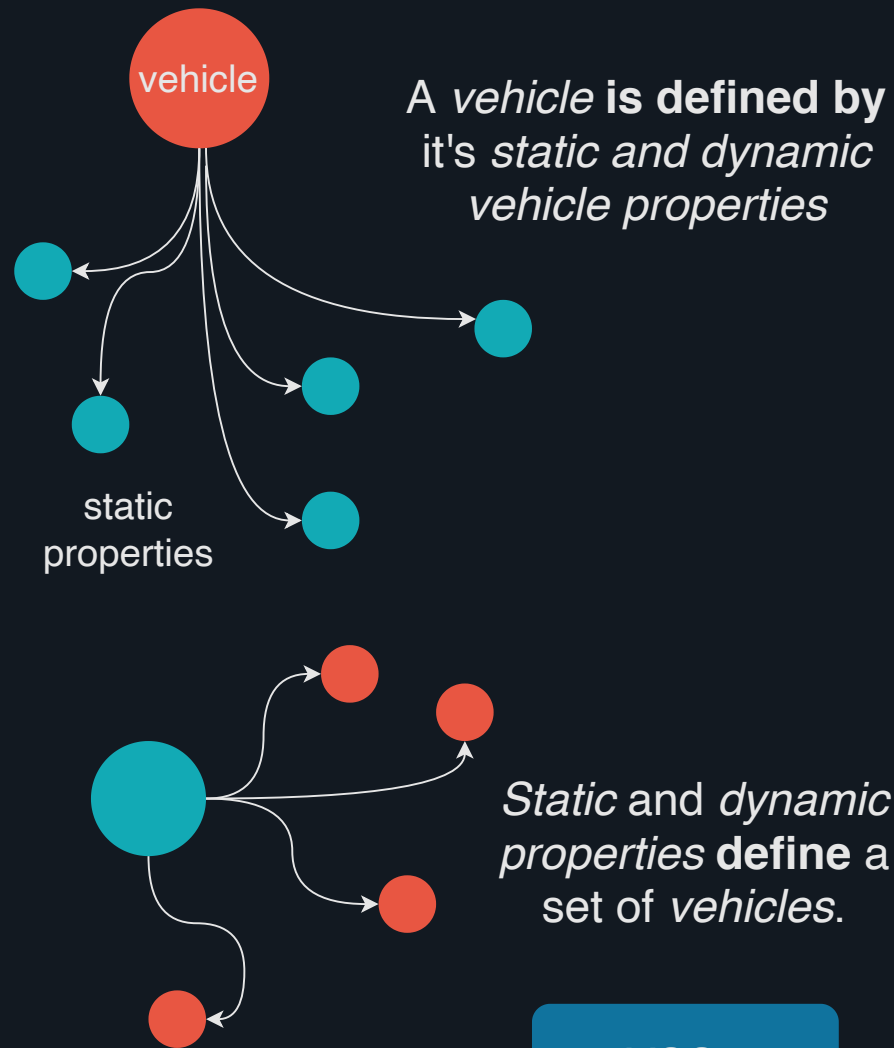
Which observations have been made at which point of time? How a data stream develops over time? Can I act on it?



ANALYTICS

Current Vehicle Data

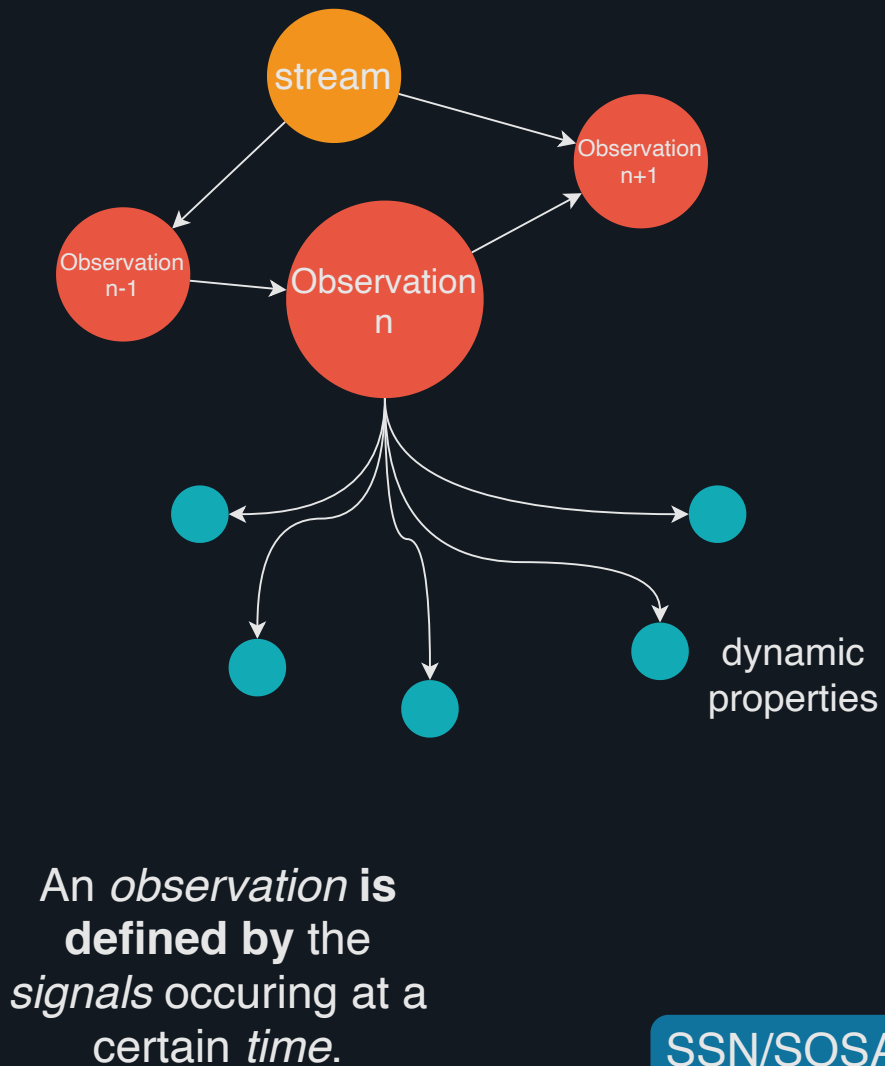
Find out what state a specific vehicle is in and how values of static and dynamic properties define a vehicle fleet.



VSSo

Dynamic Vehicle Data over Time

Which observations have been made at which point of time? How a data stream develops over time? Can I act on it?

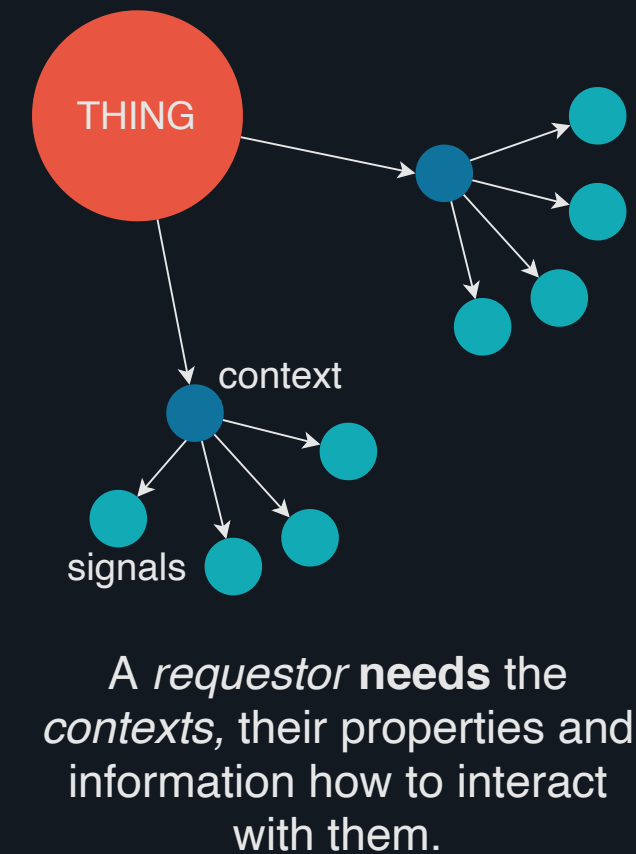


SSN/SOSA + VSSo

SERVICES

Interaction with Vehicle Data

Get specific values using a specific protocol of a specific data provider. Agreement on data exchange with unit type, etc.



WoT + VSSo

VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

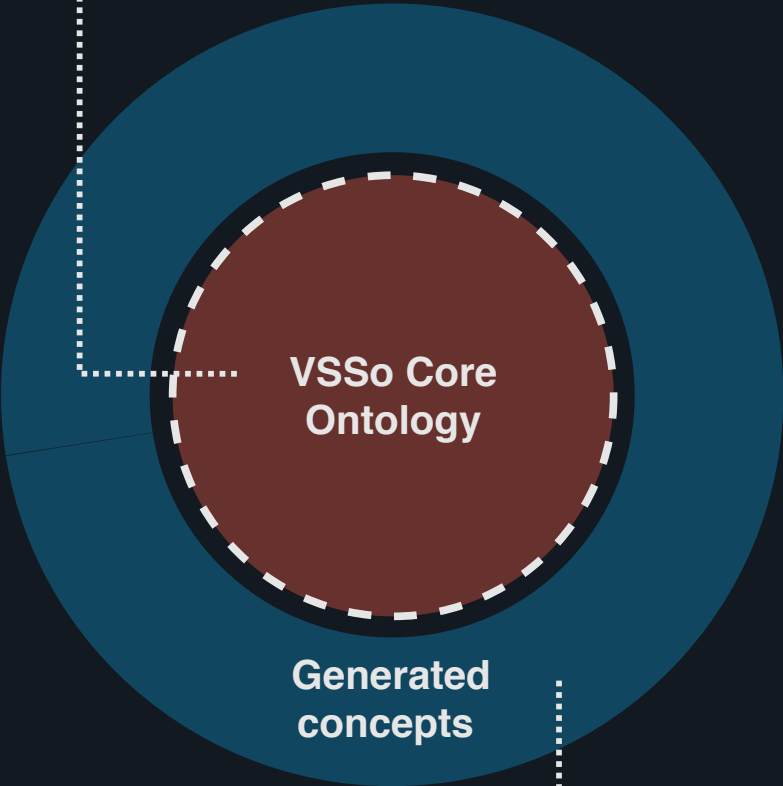
Define the core **structural** concepts of VSS (e.g. Branch, Attributes, Sensors, etc.)



VSSo Core Ontology

VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Define the core **structural** concepts of VSS (e.g. Branch, Attributes, Sensors, etc.)



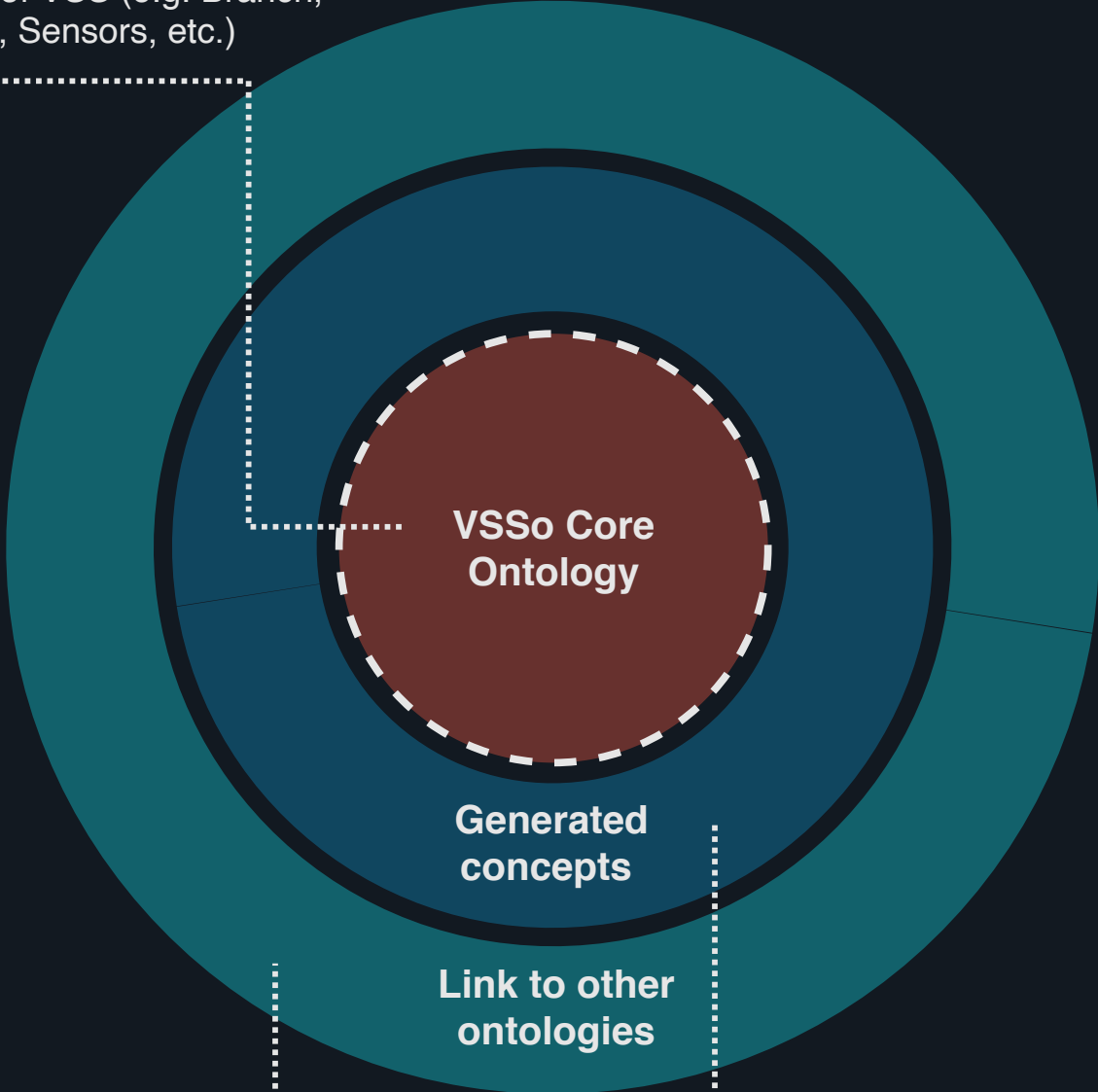
VSSo Core Ontology

Generated concepts

Generate the data definitions from VSS based on the core ontology.

VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)

Define the core **structural** concepts of VSS (e.g. Branch, Attributes, Sensors, etc.)



VSSo Core Ontology

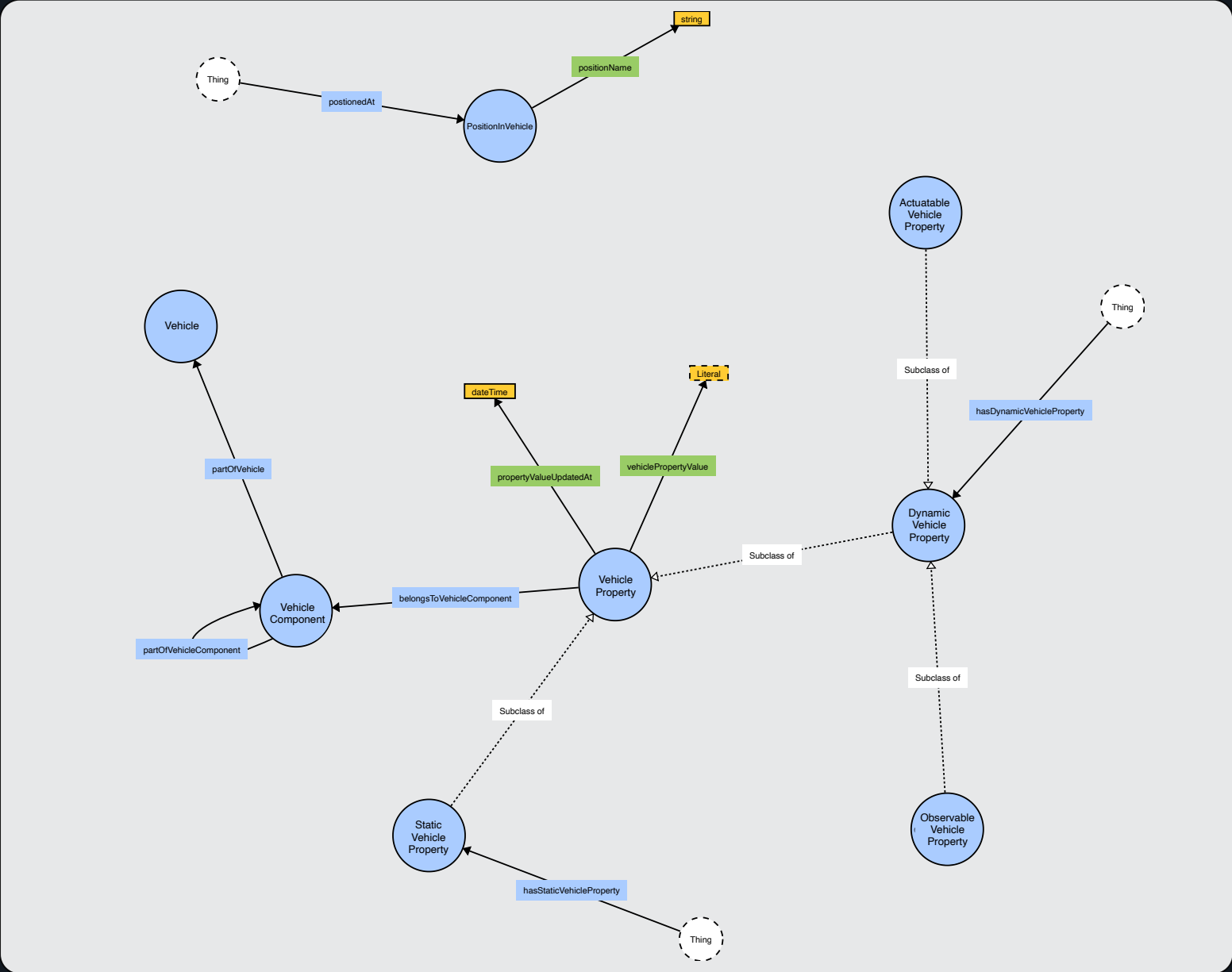
Generated concepts

Link to other ontologies

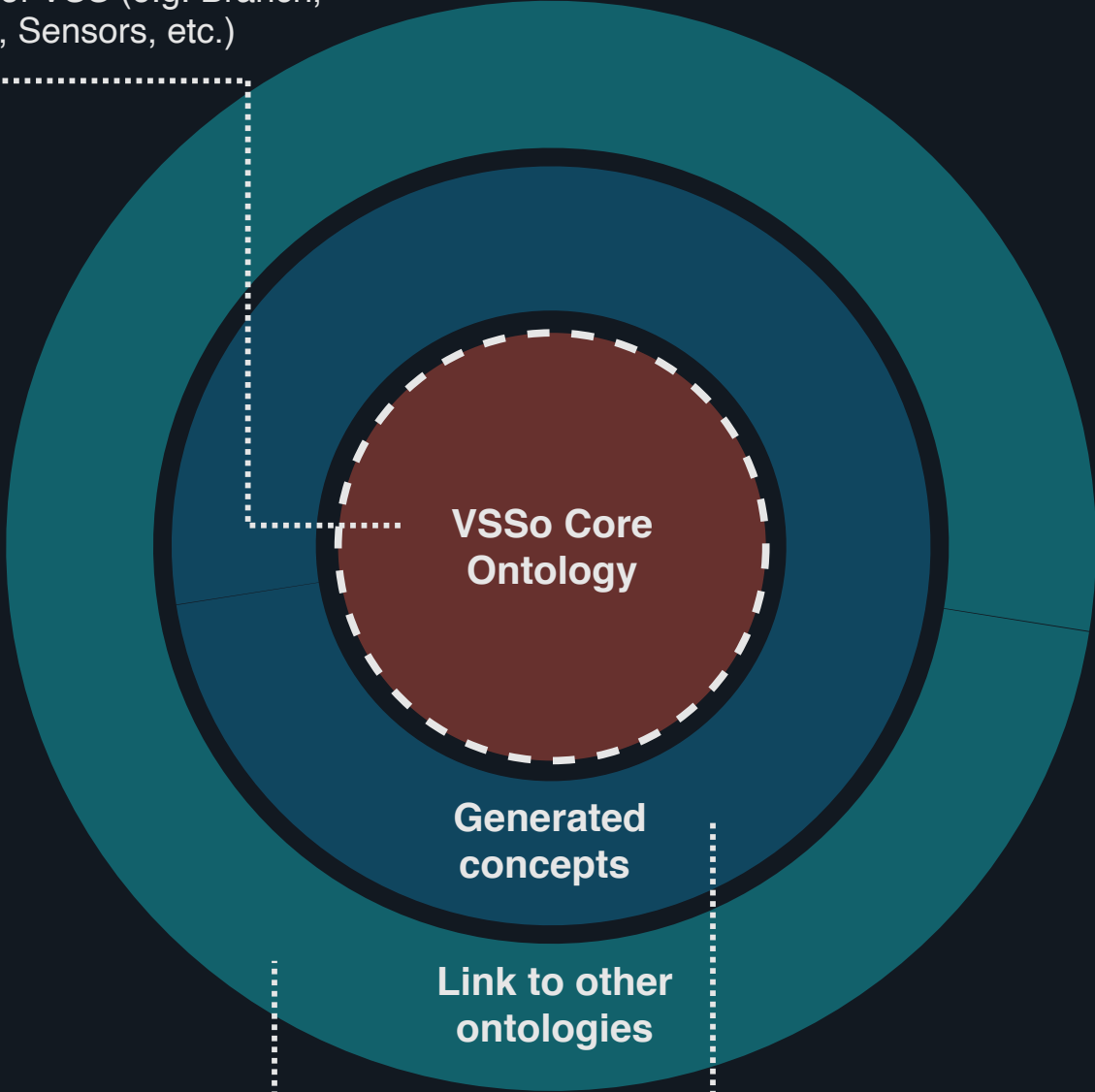
Use VSSo as domain ontology for other, widely adopted standards (SSN/SOSA).

Generate the data definitions from VSS based on the core ontology.

VEHICLE SIGNAL SPECIFICATION ONTOLOGY (VSSo)



Define the core **structural** concepts of VSS (e.g. Branch, Attributes, Sensors, etc.)



Use VSSo as domain ontology for other, widely adopted standards (SSN/SOSA).

Generate the data definitions from VSS based on the core ontology.

Conclusion

Conclusion:

- VSS is easy to understand and use as long as you stay in the automotive domain. No prior knowledge in ontologies needed.
- VSSo relies on VSS. Core Ontology can be used for extensions, VSSo is used for concepts generated from VSS.

Outlook:

- Improve the tooling and refine the core ontology



<https://github.com/w3c/vsso>



https://github.com/GENIVI/vehicle_signal_specification