CATENA-X

STANDARD

CX - 0038 Semantic Model: Fleet Diagnostic Data

BUSINESS DOMAIN: PLM & QUALITY

USE CASE: LIVE QUALITY LOOPS

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Note: Please specify the platform capability in the email subject line.

Version	1.0.1	
Date	06.03.2023	
Status	Published	
Author	Catena-X Automotive Network e.V.	
Version History		
Version	**Date**	**Description of Change**
1.0.0	30. November 2022	Initial version by Catena-X Association
1.0.1	06. March 2023	Addendum for Conformity Assessment added

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ABOUT THIS DOCUMENT & MOTIVATION

Catena-X is the first open and collaborative data ecosystem. The goal is to provide an environment for the creation, operation, and joint use of end-to-end data chains along the entire automotive value chain. All partners are on an equal ground, have sovereign control over their data and no lock-in effects occur. This situation provides a sustainable solution for the digitalization of supply chains, especially for medium-sized and small companies, and supports the cooperation and collaboration of market participants and competitors.

The ever-growing Catena-X ecosystem will enable enormous amounts of data to be integrated and collaboratively harnessed. To ensure that these complex data volumes can be sent, received, and processed smoothly across all stages of the value chain, one language for all players: common standards.

The standards of the Catena-X data ecosystem define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

Common standards create added value for all partners: Within our network, data flows more smoothly through interfaces. In addition, we avoid cumbersome individual IT solutions for sharing data with other partners. In the field of international standardization, Catena-X follows the proven international standardization institutions: ISO/IEC/ITU and CEN-CENELC/ETSI.

For users and data providers, implementation of standards will reduce the costs that would arise from adapting different systems. In addition, no important data is lost. On the contrary, it even becomes easier to collect data across companies. For operators and developers, standards will create a framework that provides reliable orientation and planning security.

The following document describes one of the reference implementations used in the Catena-X ecosystem and the requirements needed to implement it. Here, it serves as main resource to illustrate the following data model. It contains information starting from the format of the model, up to the conceptual and physical model. Defining the data model as a reference implementation enables faster information exchange and homogeneity across the Catena-X ecosystem.

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[1] https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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[1] https://catena-x.net/de/standardisierung/catena-x-einfuehren-umsetzen/standardisierung/standard-library

MANAGEMENT SUMMARY

The Catena-X use case Live Quality Loops (QAX) provides the ability to detect quality issues the earliest possible to start root cause analyses and/or to enable an early warning feature for new quality topics. In subsequent steps, counter measures can also be defined earlier and monitored. In sum, this reduces the number of vehicles affected by quality issues and increases the availability of the vehicle and built-in components. Catena-X use case Live Quality Loops is powered by Catena-X standard core components to share data from OEM and suppliers based on data sharing agreements and usage policies.

The Catena-X use case Live Quality Loops (QAX) uses multiple data models to exchange data between automotive manufacturer (OEM) and component supplier (TIER1). Each of these data models can be supplied independently.

The Fleet.DiagnosticData model is used to exchange vehicle diagnostic data coming from multiple vehicles that are affected by a Catena-X QualityTask. For investigation, diagnostic data from similar vehicles that are not affected by a Catena-X QualityTask is exchanged as well.

1 INTRODUCTION

A quality topic has different natures: Proactive quality and reactive quality work.

Example for proactive quality work: A component supplier (TIER1) releases a new component for a vehicle. The TIER1 delivers this component to an automotive manufacturer (OEM). The OEM launches a new vehicle model with this component.

For both companies, the end-user experience of this component/of the new vehicle is key. Therefore, they align in a Catena-X QualityTask to exchange anonymized component performance data from the real vehicle to closely track the behavior of this component. They use Catena-X core infrastructure to exchange relevant data and start the collaborative quality monitoring.

Example for reactive quality work: More and more end-customers are complaining about a potentially faulty component in a specific vehicle model. The component supplier (TIER1) and the automotive manufacturer (OEM) are defining a Catena-X QualityTask to eliminate this quality topic.

They use Catena-X core infrastructure to exchange relevant data and start the collaborative quality work to define countermeasures for the root cause(s).

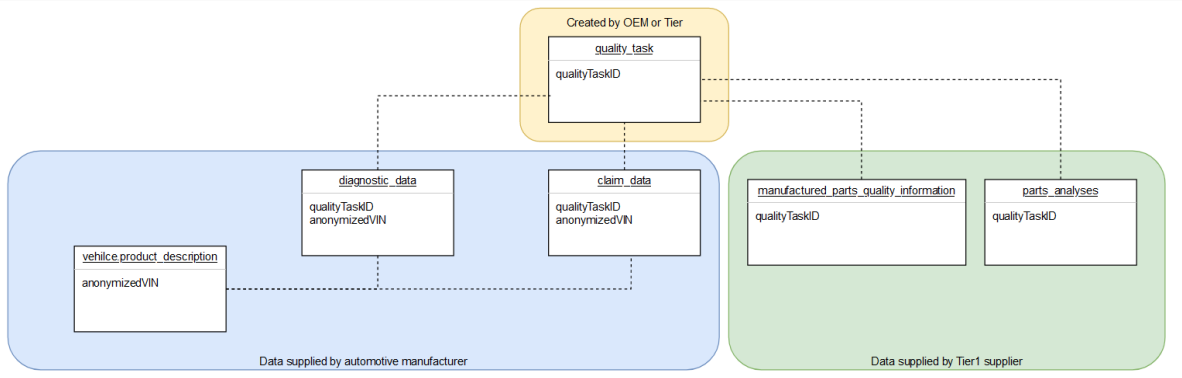

Figure 1: Hierarchy of Catena-X Live Quality Loops data models

Data models in QAX and their content:

- QualityTask is the root element and describes why companies are working together on a quality topic and what they want to do. All involved companies and their contact people are named. In addition, a flag tells what should be done with exchanged data after a QualityTask is closed.
- Vehicle.ProductDescription: This data model is a representation of one vehicle affected by this QualityTask. The model represents the vehicle when it was sold to the end-customers from an end-customers point of view: Which standard equipment was installed in the vehicle and which extra equipment was installed in the vehicle.

- Fleet.DiagnosticData: Diagnostic data coming from multiple vehicles that are affected by this QualityTask + Diagnostic data from similar vehicles that are not affected by this QualityTask.
- Fleet.ClaimData: Customer complaints that are linked to this QualityTask + Data about the exchange of potentially faulty parts
- ManufacturedPartsQualityInformation: A selection of manufacturing-related parameters that help to solve the QualtiyTask
- PartsAnalyses: Analyses results of replaced potentially faulty parts that are linked to this QualityTask

The general structure of the Fleet.DiagnosticData is a list of diagnostic sessions. Each diagnostic session come from a vehicle. A diagnostic session has general properties (e.g. quality Task ID, an OEM-internal session ID, creation date) and some other properties.

The Fleet DiagnosticData includes more entities. There is an entity, vehicle, that groups all vehicle-related properties, like anonymizedVin and catenaXId, software category and software version of the vehicle at the beginning of this diagnostic session.

The entity "workshop" can be used to give a reference to the workshop where this diagnostic session was created. Latitude and longitude can be used for bigger countries to better identify where this workshop is located (e.g. hot region, cold region).

There is a list of electronical control unit entities (ECUs) that are present in this diagnostic session: Either because they recorded a diagnostic trouble code (DTC) or if they recorded an environment condition or an event. One entity ECU groups all relevant properties, e.g. name, description, serial part number, current software and many more. The reference to one ECU is always the ecuSerialPartNumber property.

Diagnostic trouble codes (DTC) are modelled as a list. Each DTC groups relevant properties, like first occurrence mileage, first occurrence date, occurrence counter, etc. There are DTCs that are normed by an ISO standard. Most of the normed DTCs are powertrain/exhaust-treatment-related. Besides that, there is an increasing number of DTCs that are OEM-specific. To capture these DTCs the dtcHexValue is used together with the dtcDescription. Each DTC entity needs a link to the corresponding ECU via ecuSerialPartNumber.

Environment conditions are measured conditions like outside temperature. These environment conditions can be measured by the vehicle itself or by an ECU.

The data model Fleet.DiagnosticData has a list of environment conditions. Each environment condition entity has a description, the measured value, a unit and a date. If the environment condition comes from an ECU, the property

ecuSerialPartNumber is set. If the environment condition was measured on vehicle-level, this reference is empty.

At last, there is a list of “events”. Each event can be recorded on vehicle level or on ECU level. In case of vehicle level, the reference ecuSerialPartNumber is empty. An event can be recalibration of an ECU, a software update, etc.

2 PURPOSE OF THE DOCUMENT

The purpose of this document is to make the reader familiar with the Catena-X use case Live Quality Loops (QAX) and the Catena-X data models that were defined by QAX. In the Fleet.DiagnosticData model, diagnostic data is coming from vehicles that are either affected or not affected by this Quality Task. The reader of this document should be able to understand the core principles of this Catena-X data model.

The Fleet.DiagnosticData model is one of the biggest data models from the Catena-X use case Live Quality Loops (QAX). The model can transport stationary diagnostic data that is done in a workshop, as well as diagnostic data coming from connected vehicles over-the-air. The general structure of the Fleet.DiagnosticData model is a list of diagnostic sessions. Each diagnostic session comes from a vehicle.

3 SCOPE OF THE IMPLEMENTATION

This chapter serves to situate the given reference implementation, to outline its prerequisites and to point out its limitations.

3.1 PRECONDITIONS AND DEPENDENCIES

Like all Catena-X data models, this model will be available in a machine-readable format on GitHub[1].

This aspect model is written in BAMM 2.0 as a modeling language, which is a separate industry standard from the open manufacturing platform, see Open Manufacturing[2].

The data contained in this Catena-X data model is requested and exchanged via Catena-X using an Eclipse Dataspace Connector (EDC), which is a separate Catena-X standard and an implementation of the IDSA standard.

The recommendation is to use Apache parquet[4] file format together with EDC S3 data plane for file data exchange.

3.2 CONSTRAINTS AND LIMITATIONS

There are no constraints and limitations to this reference implementation document.

3.3 LICENSE

This Catena-X data model is an outcome of Catena-X use case group Live Quality Loops (QAX). This Catena-X data model is made available under the terms of the Creative Commons Attribution 4.0 International (CC-BY-4.0) license, which is available at Creative Commons[3].

[1] https://github.com/eclipse-tractusx/sldt-semantic-models.

[2] https://openmanufacturingplatform.github.io/

[3] https://creativecommons.org/licenses/by/4.0/legalcode

[4] https://parquet.apache.org/

4 DATA MODEL

The data model is described in BAMM and is available in the semantic hub from which the following description originates.

4.1 OVERVIEW

The data model can be described in different formats. The graphical representation of this data model can be found in the annex.

Diagnostic Data	
Description	Data model for vehicle diagnostic data suitable for mass data transfer
Name	DiagnosticData

4.2 PROPERTIES

A property of a BAMM Aspect Meta Model represents a named value. The following are the properties that refer to the aspect of the model.

Diagnostic sessions	
Description	List of diagnostic sessions, e.g. from a list of vehicles/fleet
Name	diagnosticSessions
Characteristic	A list of diagnostic sessions. Each diagnostic session should be represented only one time. urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#DiagnosticSession
Optional	No
In Payload	Yes
Payload Key	diagnosticSessions

4.3 ENTITIES

An entity is a logical encapsulation of multiple values. It has a number of properties, which are described in the following, starting with the entity, followed by its properties.

4.3.1 Properties of Entity DTC

DTC	
Description	Diagnostic trouble codes or short DTCs are used inside ECUs to monitor failures. They were introduced for measuring vehicle emissions. Major DTCs for emissions are standardized by ISO standard ISO 15031-6:2015 - so called OBD2 standard.

	Over time DTCs were also introduced in other ECUs, also besides engine and emission control. Many DTCs are vehicle manufacturer specific.
Name	DTC
Reference	https://www.iso.org/standard/66369.html

ECU serial part number	
Description	Serial number of ECU
Name	ecuSerialPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	74343070GHKER73727
Optional	No
In Payload	Yes
Payload Key	ecuSerialPartNumber

Hex		
Description	Hex value of this DTC	
Name	dtcHexValue	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	4337499FF	
Optional	Yes	
In Payload	Yes	
Payload Key	dtcHexValue	
Constraints	HexRegex	
	Description	A freeze frame contains only hex chars 0-9, A-F, a-f. Restricted to 8000
	Regular expression	^[0-9,A-F,a-f]$

DTC full name	
Description	Combined string of DTC name plus the so called DTC sub type or DTC failure byte. Both string values are concatenated using a "-" as separator. DTC name is: BICIPIU + 4 hex chars

	DTC failure byte: 2 hex chars In some rare cases this could be just a hex string	
Name	fullName	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	P0573-00	
Optional	No	
In Payload	Yes	
Payload Key	fullName	
Constraints	FullDTCRegEx	
	Description	DTC regular expression to ensure BICIUIP followed by 4 hex chars followed by "-" followed by 2 hex chars
	Regular expression	^[BICIPIU]{1}[0-9,A-F,a-f]{4}[-]{1}[0-9,A-F,a-f]{2}$

DTC description	
Description	Description of DTC and failure byte. Both description strings are concatenated using a "-" as separator
Name	fullDescription
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Brake Switch "A" Circuit High-no sub type information
Optional	No
In Payload	Yes
Payload Key	fullDescription

DTC first occurrence	
Description	Date and time when the DTC occurred the first time/was recorded the first time in the ECU
Name	occurenceDateTime
Characteristic	Type http://www.w3.org/2001/XMLSchema#dateTime
Example	2022-01-30T14:48:54
Optional	No
In Payload	Yes

Payload Key	occurenceDateTime

DTC state	
Description	OEM-specific state of DTC: 0;1 (permanent/temporary/intermediate), could also be a string with permanent, temporary, intermediate, etc.
Name	state
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	permanent
Optional	No
In Payload	Yes
Payload Key	state

Is MIL On	
Description	Describes whether this DTC set the MIL (malfunction indicator light) in the dashboard
Name	isMilOn
Characteristic	Type http://www.w3.org/2001/XMLSchema#boolean
Example	true
Optional	Yes
In Payload	Yes
Payload Key	IsMilOn

DTC first occurrence mileage	
Description	Mileage in km when the DTC occurred the first time
Name	occurenceMileage
Characteristic	Measurement Mileage counter of the car Unit Kilometer Symbol km Code KMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#positiveInteger

Example	15000
Optional	No
In Payload	Yes
Payload Key	occurenceMileage

DTC fault path	
Description	OEM-specific: Fault path for this DTC. Allows further analysis
Name	faultPath
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	1000761
Optional	No
In Payload	Yes
Payload Key	faultPath

DTC fault path description	
Description	OEM-specific description of DTC fault path
Name	faultPathDescription
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Shortage to plus
Optional	No
In Payload	Yes
Payload Key	faultPathDescription

Type	
Description	Indicator whether this DTC was stored as error or Info
Name	type
Characteristic	Characteristic Enumeration Values Error Info Type http://www.w3.org/2001/XMLSchema#string
Example	Error
Optional	Yes

In Payload	Yes
Payload Key	type

Occurrence counter		
Description	Counter how often this DTC was set in total	
Name	occurrenceCounterTotal	
Characteristic	Type http://www.w3.org/2001/XMLSchema#long	
Example	10	
Optional	Yes	
In Payload	Yes	
Payload Key	occurrenceCounterTotal	

DTC freeze frame		
Description	Freeze frame from ECU. The freeze frame records many parameters of the DTC and surrounding parameters like outside temperature when the DTC was set. It is a very long HEX string with many OEM-specific and ECU-specific content in	
Name	freezeFrame	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	100148340349340	
Optional	Yes	
In Payload	Yes	
Payload Key	freezeFrame	
Constraints	HexRegex	
	Description	A freeze frame contains only hex chars 0-9, A-F, a-f. Restricted to 8000 chars
	Regular expression	^[0-9,A-F,a-f]$

4.3.2 Properties of Entity Diagnostic Session

DiagnosticSession	
Description	One diagnostic session of one vehicle: Depending on the diagnostic software used in either workshops or over-the-air diagnostics, one session can be defined differently: - Workshop diagnostic: Normally for each command to the diagnostic tester, there is a session diagnostic file created, that is later send to the OEM backend system. Examples for one command: Read-out all ECUs with its DTCs or do a software upgrade of one ECU - Over-the-air: E.g. one diagnostic snapshot is taken after ignition-on. In addition a list of environment conditions can be placed, as well as a list of AdditionalInfos. Both lists are on DiagnosticDataSession level, because they can be valid for the whole vehicle (e.g. environment temperature) or only for a specific ECU (e.g. wheel speed sensor at ABS ECU)
Name	DiagnosticSession

Creationdate	
Description	Date-timestamp for this session according to ISO 8601 when this session was created. Depending on OEM this attribute reflects the start or end date of one diagnostic session.
Name	creationDate
Characteristic	Type http://www.w3.org/2001/XMLSchema#dateTime
Example	2022-02-04T14:48:54
Optional	No
In Payload	Yes
Payload Key	creationDate

Session identifier	
Description	Format is OEM-specific: A unique session identifier within one OEM.
Name	sessionId
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Example	3747429FGH382923974682
Optional	No
In Payload	Yes
Payload Key	sessionId

Quality Task ID		
Description	A unique quality task identifier, where these lists of session data belong to. Optional to ensure that also diagnostic data without quality task can be exchanged.	
Name	qualityTaskId	
Characteristic	Type http://www.w3.org/2001/XMLSchema#string	
Example	BPN-811_2022_000001	
Optional	Yes	
In Payload	Yes	
Payload Key	qualityTaskId	

Country Code		
Description	Country code in ISO 3166-1 alpha-3 codes, where this session took place	
Name	countryCode	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	DEU	
Optional	No	
In Payload	Yes	
Payload Key	countryCode	
Constraints	Country Code Regular Expression	
	Description	Regular Expression that ensures a three-letter code
	Regular Expression	^[A-Z][A-Z][A-Z]$

Session mileage	
Description	Current mileage counter of the car during the diagnostic session

Name	mileage
Characteristic	Measurement Mileage counter of the car Unit Kilometer Symbol km Code KMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#positiveInteger
Example	23500
Optional	No
In Payload	Yes
Payload Key	mileage

vehicle	
Description	Vehicle that was present in the diagnostic session
Name	vehicle
Characteristic	SingleEntity Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#Vehicle
Optional	No
In Payload	Yes
Payload Key	Vehicle

workshop	
Description	Due to the fact that diagnostic over the air is also possible, a Workshop entity is optional
Name	workshop
Characteristic	SingleEntity Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#Workshop
Optional	Yes
In Payload	Yes

Payload Key	workshop

ECU list	
Description	List of ECUs that had an entry in its internal failure memory during the diagnostic session
Name	ecuList
Characteristic	A list of all installed ECUs. Each ECU should appear only one time. Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#ECU
Optional	No
In Payload	Yes
Payload Key	ecuList

dtcList	
Description	List of diagnostic trouble codes
Name	dtcList
Characteristic	A list of DTCs. Each DTC in each ECU should appear only one time Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#DiagnosticTroubleCode
Optional	Yes
In Payload	Yes
Payload Key	dtcList

Environment Conditions	
Description	A list of environment conditions: E.g. outside temperature measured by the vehicle, a specific value measured by one ECU, etc.
Name	envConditionList
Characteristic	A list of environment condition. Each environment condition should appear only one time. Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#EnvironmentCondition

Optional	Yes
In Payload	Yes
Payload Key	envConditionList

Events	
Description	A list of additional events that were performed during one diagnostic session: Calibration event, SW update event
Name	eventList
Characteristic	A list of events. Each event should appear only one time. Type urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0#Event
Optional	Yes
In Payload	Yes
Payload Key	eventList

4.3.3 Properties of Entity ECU

ECU	
Description	A single ECU that is present/has a DTC set in the diagnostic session
Name	ECU

Catena-X Identifier	
Description	A fully anonymous Catena-X identifier that is registered in the C-X Digital twin registry. This property can be used for vehicles, parts, workshops, etc. Optional: Not always available
Name	catenaXId
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379
Optional	Yes
In Payload	Yes
Payload Key	CatenaXId
Constraints	Catena-X Id Regular Expression

	Description	The provided regular expression ensures that the UUID is composed of five groups of characters separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 hexadecimal characters and 4 hyphens), prefixed by "urn:uuid:" to make it an IRI.
	Reference	https://datatracker.ietf.org/doc/html/rfc4122
	Regular expression	^urn:uuid:[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{12}$

ECU serial part number	
Description	Serial number of ECU
Name	ecuSerialPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	74343070GHKER73727
Optional	No
In Payload	Yes
Payload Key	ecuSerialPartNumber

ECU name	
Description	Name of ECU
Name	Name
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Exercise	ABS
Optional	No
In Payload	Yes
Payload Key	Name

ECU description

Description	Long name of ECU
Name	Description
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Anti-blocking control unit
Optional	No
In Payload	Yes
Payload Key	description

ECU HW part number	
Description	Hardware part number of ECU
Name	hwPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	04C907309AE
Optional	No
In Payload	Yes
Payload Key	hwPartNumber

ECU HW version	
Description	Hardware version of ECU
Name	hwVersion
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	0556A
Optional	No
In Payload	Yes
Payload Key	hwVersion

ECU SW part number	
Description	SW part number of this ecu
Name	swPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	04C906026BH
Optional	No
In Payload	Yes

Payload Key	swPartNumber

ECU SW version	
Description	Current version of the software on this ECU
Name	swVersion
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	0001
Optional	No
In Payload	Yes
Payload Key	swVersion

ECU assembly part number	
Description	OEM-specific ECU assembly from hardware and software
Name	assemblyPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	V03935278E
Optional	Yes
In Payload	Yes
Payload Key	assemblyPartNumber

ECU assembly part number version	
Description	OEM-specific ECU assembly version
Name	assemblyPartNumberVersion
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	0001
Optional	Yes
In Payload	Yes
Payload Key	Type http://www.w3.org/2001/XMLSchema#string

Read out date	
Description	Date when this ECU information was read out from the diagnostic session
Name	readOutDate

Characteristic	Type http://www.w3.org/2001/XMLSchema#dateTime
Example	2022-01-30T14:45:54
Optional	No
In Payload	Yes
Payload Key	readOutDate

4.3.4 Properties of Entity Environment Condition

Environment Condition	
Description	One environment condition, like temperature, rpm, etc. If the environment condition was measured on vehicle level, ecuSerialPartNumber is empty
Name	Environment Condition

Id	
Description	OEM-specific: Primary key for this condition consists of unique identifier of env. condition and DTC
Name	conditionId
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DTC1_EnvCond1
Optional	No
In Payload	Yes
Payload Key	conditionId

Creation Date	
Description	Date and time when this condition/information was created.
Name	conditionCreationDate
Characteristic	Type http://www.w3.org/2001/XMLSchema#dateTime
Example	2022-01-28T14:48:54
Optional	No
In Payload	Yes
Payload Key	conditionCreationDate

Description	
Description	The description of the environment condition/information

Name	conditionDescription
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	RPM
Optional	No
In Payload	Yes
Payload Key	conditionDescription

Value	
Description	The numeric value (if applicable) of the stored environment condition at the time of the DTC.
Name	conditionValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#double
Example	2000.0
Optional	No
In Payload	Yes
Payload Key	conditionValue

DTC fault path	
Description	The unit of measurement for the environment condition value.
Name	measurementUnit
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	rpm
Optional	No
In Payload	Yes
Payload Key	measurementUnit

ECU serial part number	
Description	Serial number of ECU
Name	ecuSerialPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	74343070GHKER73727
Optional	Yes

In Payload	Yes
Payload Key	ecuSerialPartNumber

Hex		
Description	Hex value of this DTC	
Name	dtcHexValue	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	4337499FF	
Optional	Yes	
In Payload	Yes	
Payload Key	DtcHexValue	
Constraints	HexRegex	
	Description	A freeze frame contains only hex chars 0-9, A-F, a-f. Restricted to 8000 chars
	Regular	^[0-9, A-F, a-f]$

4.3.5 Properties of Entity Event

Event	
Description	If additional information/events are available during this session: This object can be used for calibration information, software updates, etc. If this event was measured on vehicle level, ecuSerialPartNumber is empty
Name	Event

Id	
Description	OEM-specific: Primary key for this event
Name	eventId
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	ABS_CAL1234
Optional	No
In Payload	Yes
Payload Key	eventId

Creation Date	
Description	Date and time when this event was created
Name	eventCreationDate
Characteristic	Type http://www.w3.org/2001/XMLSchema#dateTime
Example	2022-01-30T14:00:00
Optional	No
In Payload	Yes
Payload Key	eventCreationDate

Description	
Description	The description of the event
Name	eventDescription
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Calibration of ABS ecu
Optional	No
In Payload	Yes
Payload Key	eventDescription

Value	
Description	The value of this event. For example, the calibration file used.
Name	eventValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	CAL366474-4848
Optional	No
In Payload	Yes
Payload Key	eventValue

ECU serial part number	
Description	Serial number of ECU
Name	ecuSerialPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Example	74343070GHKER73727
Optional	Yes
In Payload	Yes
Payload Key	ecuSerialPartNumber

Hex		
Description	Hex value of this DTC	
Name	dtcHexValue	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	4337499FF	
Optional	Yes	
In Payload	Yes	
Payload Key	dtcHexValue	
Constraints	HexRegex	
	Description	A freeze frame contains only hex chars 0-9, A-F, a-f. Restricted to 8000 chars
	Regular expression	^[0-9,A-F,a-f]$

4.3.6 Properties of Entity Vehicle

Vehicle	
Description	All attributes to clearly identify the vehicle during this diagnostic session
Name	Vehicle

Anonymized VIN	
Description	OEM-specific hashed VIN; link to car data over pseudonymized/hashed VIN or Catena-X unique digital twin identifier
Name	anonymizedVIN
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	3747429FGH382923974682
Optional	No

In Payload	Yes
Payload Key	anonymizedVIN

Catena-X Identifier		
Description	A fully anonymous Catena-X identifier that is registered in C-X Digital twin registry. This property can be used for vehicles, parts, workshops, etc. Optional, not always available	
Name	catenaXId	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379	
Optional	Yes	
In Payload	Yes	
Payload Key	catenaXId	
Constraints	Catena-X Id Regular Expression	
	Description	The provided regular expression ensures that the UUID is composed of five groups of characters separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 hexadecimal characters and 4 hyphens), prefixed by "urn:uuid:" to make it an IRI.
	Reference	https://datatracker.ietf.org/doc/html/rfc4122
	Regular expression	^urn:uuid:[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{12}$

Vehicle software category	
Description	Software category of this car during the session - only available for OEMs that have a software category on vehicle level

Name	softwareCategory
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	TZGH64738
Optional	Yes
In Payload	Yes
Payload Key	softwareCategory

Vehicle software version	
Description	Software version of this car during the session - only available for OEMs that have a software category on vehicle level
Name	softwareVersion
Characteristic	Type http://www.w3.org/2001/XMLSchema#strin
Example	3.5.0001.001
Optional	Yes
In Payload	Yes
Payload Key	softwareVersion

4.3.7 Properties of Entity Workshop

Workshop	
Description	All attributes to clearly identify this workshop
Name	workshop

OEM Workshop ID	
Description	OEM internal workshop ID
Name	workShopId
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	4563328
Optional	No
In Payload	Yes
Payload Key	workShopId

Catena-X Identifier

Description	A fully anonymous Catena-X identifier that is registered in C-X Digital twin registry. This property can be used for vehicles, parts, workshops, ...etc. Optional, not always available	
Name	catenaXId	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379	
Optional	Yes	
In Payload	Yes	
Payload Key	catenaXId	
Constraints	Catena-X Id Regular Expression	
	Description	The provided regular expression ensures that the UUID is composed of five groups of characters separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 hexadecimal characters and 4 hyphens), prefixed by "urn:uuid:" to make it an IRI.
	Reference	https://datatracker.ietf.org/doc/html/rfc4122
	Regular expression	urn:uuid:[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{12}$

Latitude	
Description	Latitude of this workshop
Name	latitude
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#float
Example	9.19968
Optional	No
In Payload	Yes

Payload Key	Latitude
Constraints	Constraint Latitude = DefaultScalarValue[value=-90.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']'] ...

Longitude	
Description	Longitude of this workshop
Name	longitude
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#float
Example	48.77765
Optional	No
In Payload	Yes
Payload Key	longitude
Constraints	ConstraintLongitude >= DefaultScalarValue[value=-180.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']'] ...

5 NORMATIVE REFERENCES

The following references refer to related Catena-X reference implementation and external standards. This is intended to place the present reference implementation in the context of existing references.

5.1 CATENA-X- REFERENCE IMPLEMENTATION

Catena-X Reference Implementations [2]	
CX - 0003	BAMM Aspect Meta Model
CX - 0004	Governance Process
CX - 0010	Business Partner Number
CX - 0018	Eclipse Data Space Connector (EDC)

5.2 COMMON STANDARDS

Common Standards	
IDSA	International Data Spaces Association [1]

[1] https://internationaldataspaces.org/we/the-association/

[2] https://catena-x.net/de/standard-library

GLOSSARY

ABBREVIATIONS

Abbreviations	Description
BAMM	BAMM Aspect Meta Model[1]
IDSA	International Data Spaces Association[2]

[1] https://openmanufacturingplatform.github.io/

[2] https://internationaldataspaces.org/we/the-association/

ADDENDUM FOR CONFORMITY ASSESSMENT

DISCLAIMER

The following pages are not part of the standard documentation.

CATENA-X

ADDENDUM FOR CONFORMITY ASSESSMENT

CX – 0038 SEMANTIC MODEL: FLEET DIAGNOSTIC DATA

BUSINESS DOMAIN: PLM & QUALITY
USE CASE: LIVE QUALITY LOOPS

Contact: standardisierung@catena-x.net
Note: Please specify the platform capability in the subject line.

TABLE OF CONTENTS

ABOUT THIS DOCUMENT & MOTIVATION

The **standards of the Catena-X data ecosystem** define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

The addendum for conformity assessment clarifies the requirements and scope for each standard. It contains conformity assessment criteria (CAC) that specify how a participant can receive a certificate for the correct application of the standard.

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[1] https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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[1] https://catena-x.net/de/standard-library

1 INTRODUCTION

This document describes the semantic model “Fleet Diagnostic Data” used in the Catena-X network.

1.1 AUDIENCE & SCOPE

This section is non-normative

The described semantic model is relevant for:

- Data Provider / Consumer
- Business Application Provider

1.2 CONTEXT

This section is non-normative

The Catena-X use case Live Quality Loops (QAX) uses multiple data models to exchange data between automotive manufacturer (OEM) and component supplier (TIER1). Each of these data models can be supplied independently.
The Fleet.DiagnosticData model is used to exchange vehicle diagnostic data coming from multiple vehicles that are affected by a Catena-X QualityTask. For investigation also diagnostic data from similar vehicles that are not affected by a Catena-X QualityTask is exchanged.

1.3 CONFORMANCE

As well as sections marked as non-normative, all authoring guidelines, diagrams, examples, and notes in this specification are non-normative. Everything else in this specification is normative.

The key words MAY, MUST, MUST NOT, OPTIONAL, RECOMMENDED, REQUIRED, SHOULD and SHOULD NOT in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.4 PROOF OF CONFORMITY

This section is non-normative

All participants and their solutions will need to prove they conform with the Catena-X standards. To validate that the standards are applied correctly, Catena-X employs Conformity Assessment Bodies (CABs).

A model validator must be created, to prove the correctness of the data model. A generic test set created for the model must prove the expected results

Examples

Example payload in JSON format:


```
{
 "diagnosticSessions" : [ {
  "eventList" : [ {
   "eventDescription" : "Calibration of ABS ecu with calib file - see value",
   "eventId" : "ABS_CAL1234",
   "ecuSerialPartNumber" : "74343070GHKER73727",
   "eventValue" : "CAL366474-4848",
   "dtcHexValue" : "4337499FF",
   "eventCreationDate" : "2022-01-30T14:00:00"
  } ],
  "envConditionList" : [ {
   "ecuSerialPartNumber" : "74343070GHKER73727",
   "conditionId" : "DTC1_EnvCond1",
   "conditionCreationDate" : "2022-01-28T14:48:54",
   "dtcHexValue" : "4337499FF",
   "conditionValue" : 2000.0,
   "conditionDescription" : "RPM",
   "measurementUnit" : "rpm"
  } ],
  "qualityTaskId" : "BPN-811_2022_000001",
  "countryCode" : "DEU",
  "workshop" : {
   "catenaXId" : "urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379",
   "workShopId" : "4563328",
   "latitude" : 9.19968,
   "longitude" : 48.77765
  },
  "dtcList" : [ {
   "ecuSerialPartNumber" : "74343070GHKER73727",
   "dtcHexValue" : "4337499FF",
   "faultPath" : "1000761",
   "occurenceDateTime" : "2022-01-30T14:48:54",
   "fullName" : "P0573-00",
   "faultPathDescription" : "shortage to plus",
   "fullDescription" : "Brake Switch \"A\" Circuit High-no sub type information",
   "type" : "Error",
   "occurenceMileage" : 15000,
   "state" : "permanent",
   "occurenceCounterTotal" : 10,
```

```
    "freezeFrame" : "100148340349340",
    "isMilOn" : true
   } ],
   "sessionId" : "3747429FGH382923974682",
   "creationDate" : "2022-02-04T14:48:54",
   "mileage" : 23500,
   "vehicle" : {
    "catenaXId" : "urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379",
    "anonymizedVIN" : "3747429FGH382923974682",
    "softwareCategory" : "TZGH64738",
    "softwareVersion" : "3.5.0001.001"
   },
   "ecuList" : [ {
    "catenaXId" : "urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9379",
    "ecuSerialPartNumber" : "74343070GHKER73727",
    "swVersion" : "0001",
    "swPartNumber" : "04C906026BH",
    "assemblyPartNumber" : "V03935278E",
    "assemblyPartNumberVersion" : "0001",
    "name" : "ABS",
    "description" : "Anti blocking control unit",
    "hwPartNumber" : "04C907309AE",
    "readOutDate" : "2022-01-30T14:45:54",
    "hwVersion" : "0556A"
   } ]
  } ]
}
```


1.5 TERMINOLOGY

This section is non-normative

Business Partner Number (BPN)
A BPN is the unique identifier of a partner within Catena-x.

2 ASPECT MODEL FLEET DIAGNOSTIC DATA

2.1 INTRODUCTION

Catena-X use case "Live Quality Loops" (QAX) uses several Catena-X standardized data models to exchange data:

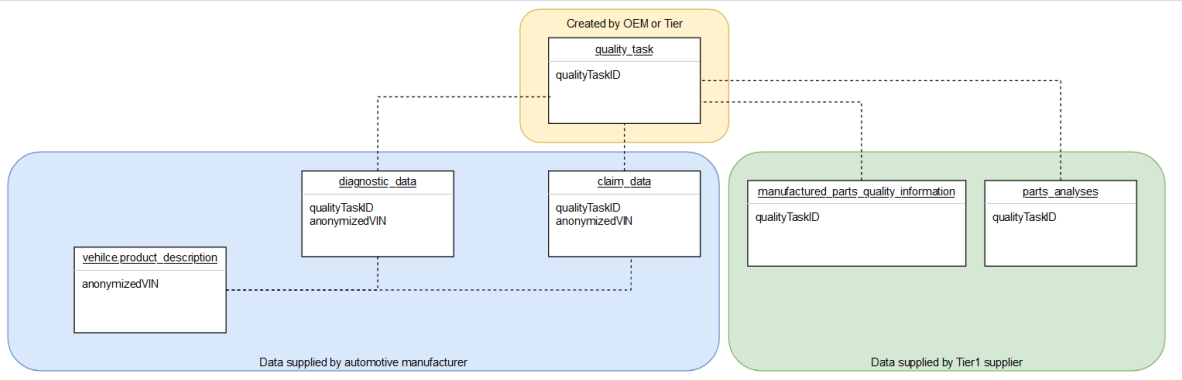

Figure 1: Hierarchy of Catena-X data models used in QAX

Data models in QAX and their content:

- QualityTask is the root element and describes why companies are working together on a quality topic and what they want to do. All involved companies and their contact people are named. In addition, a flag tells what should be done with exchanged data after a QualityTask is closed.
- Vehicle.ProductDescription: This data model is a representation of one vehicle affected by this QualityTask. The model represents the vehicle when it was sold to the end-customers from an end-customers point of view: Which standard equipment was installed in the vehicle and which extra equipment was installed in the vehicle.
- Fleet.DiagnosticData: Diagnostic data coming from multiple vehicles that are affected by this QualityTask + Diagnostic data from similar vehicles that are not affected by this QualityTask.
- Fleet.ClaimData: Customer complaints that are linked to this QualityTask + Data about the exchange of potentially faulty parts
- ManufacturedPartsQualityInformation: A selection of manufacturing-related parameters that help to solve the QualtiyTask
- PartsAnalyses: Analyses results of replaced and potentially faulty parts that are linked to this QualityTask

2.2 NORMATIVE CRITERIA

The usage of the described semantic model "Fleet Diagnostic Data" is a MUST for Data Provider and Data Consumer that want to work together on a quality topic over Catena-X automotive network.

2.2.1 Normative criteria for Data Provider

Every data provider MUST provide the data conformant to the semantic model specified in CX-0038.

It is a MUST to provide a unique sessionId. This sessionId MUST be unique in the data provider's company.

It is a MUST to provide the property "anonymizedVIN". anonymizedVIN MUST match with anonymizedVIN property of Vehicle Product Description in CX – 0037.

It is a MUST to provide the property "qualityTaskId". qualityTaskId MUST match with qualityTaskId property of Quality Task in CX – 0036.

If available property catenaXId of entity ECU and property catenaXId of entity Vehicle SHOULD be provided.

In the Catena-X data space "Fleet Diagnostic Data" MUST be exchanged via Eclipse Dataspace Connector (EDC) conformant to CX-0018 and CX-0002.

It is RECOMMEND to use Apache parquet[1] file format together with EDC S3 data plane for file data exchange "Fleet Diagnostic Data".

2.2.2 Normative criteria for Business Application Provider

It is a MUST for Business Application Provider to support at least 2 standardized Catena-X QAX aspect models from Catena-X Release 3.0 (2 out of Catena-X standards CX – 0036, CX – 0037, CX – 0038, CX – 0039, CX – 0040, CX – 0041) to get the label "Catena-X Certified Solution" for their quality application.

[1] https://parquet.apache.org/

It is RECOMMEND for Business Application Provider to be able to read the semantic model “Fleet Diagnostic Data”.

2.3 LICENSE

This Catena-X data model is an outcome of Catena-X use case group Live Quality Loops (QAX). This Catena-X data model is made available under the terms of the Creative Commons Attribution 4.0 International (CC-BY-4.0) license, which is available at Creative Commons[1].

The license information is available in github.

In case of doubt the license, copyright and authors information in github overwrites the information in this specification document.

2.4 IDENTIFER OF SEMANTIC MODEL

This semantic model has the unique identifier
urn:bamm:io.catenax.fleet.diagnostic_data:1.0.0

2.5 FORMATS OF SEMANTIC MODEL

2.5.1 RDF Turtle

The rdf turtle file, adhering to the Semantic Aspect Meta Model, is the master for generating additional file formats and serializations. It is provided here:

https://github.com/eclipse-tractusx/sldt-semantic-models/tree/main/io.catenax.fleet.diagnostic_data/1.0.0

The open source command line tool of the Eclipse Semantic Modeling Framework[2](ESMF) is used for generation of other file formats like for example a JSON Schema, aasx for Asset Administration Shell Submodel Template or a HTML documentation.

2.5.2 JSON Schema

A JSON Schema can be generated from the RDF Turtle file using the Eclipse ESMF tooling. The JSON Schema defines the Value-Only payload of the Asset Administration Shell for the API operation "GetSubmodel".

[1] https://creativecommons.org/licenses/by/4.0/legalcode
[2] https://github.com/eclipse-esmf/esmf-sdk

If present, example JSON-payloads MUST validate against the generated JSON schema.

3 REFERENCES

3.1 NORMATIVE REFERENCES

- CX-0003 SEMANTIC ASPECT META MODEL
- CX-0004 GOVERNANCE PROCESS FOR SEMANTIC MODELS
- CX-0018 ECLPISE DATA SPACE CONNECTOR (EDC)