



TCCS Diagnostics and Configuration

Service Function Diagnostics & Data Sharing

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Rail Data Forum 2025

Cluj-Napoca, Romania, 12.06.2025





Operational User Stories

As a **maintainer**,

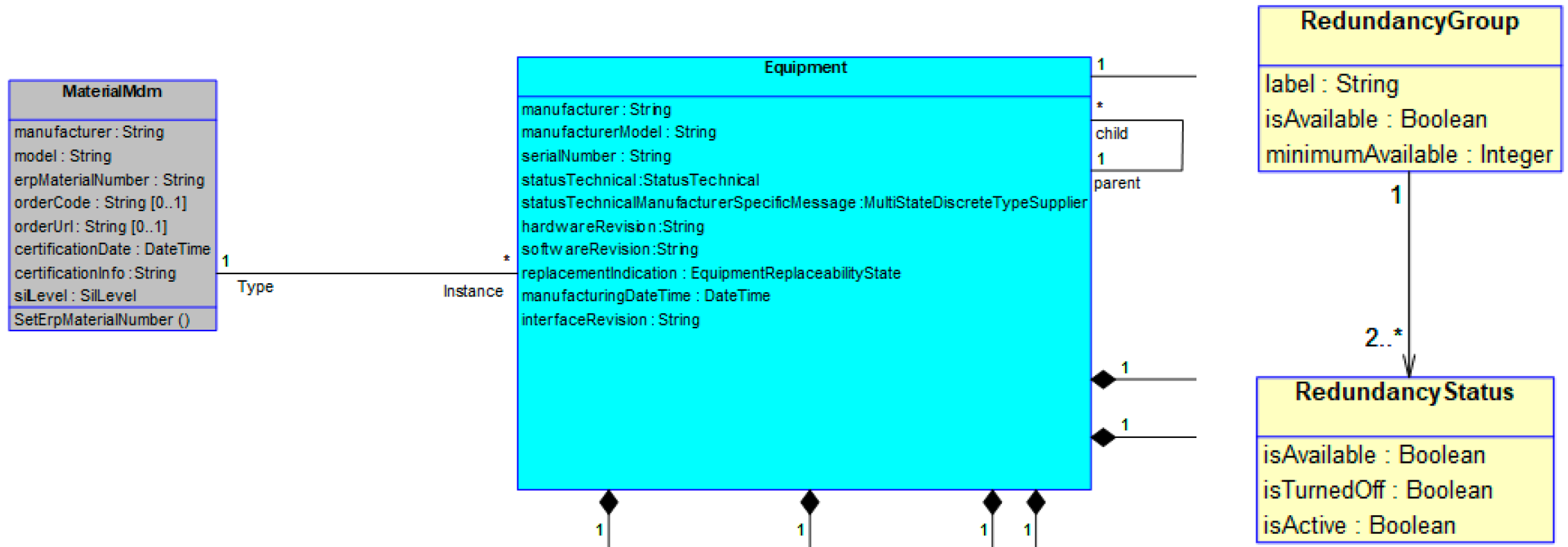
I want standardized, up-to-date asset and diagnostic data
so that I can efficiently detect, understand, and
resolve faults across systems and manufacturers.

Key Needs:

- **Understand data:** standardized models & semantics
- **Localize faults:** Precise identification (LRUs)
- **Repair Efficiency:** Correct material on-site

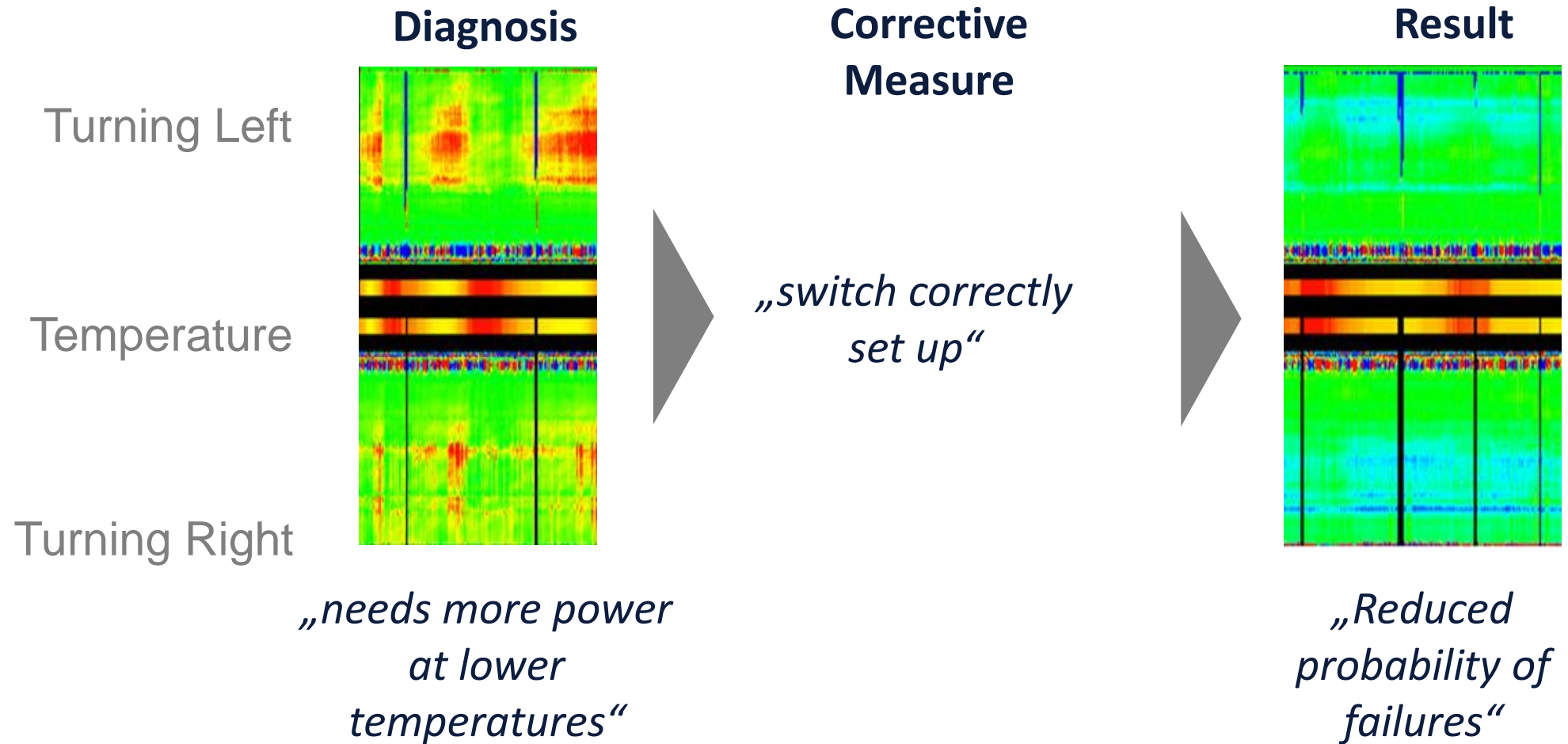


Online Inventory “physical” Equipment model



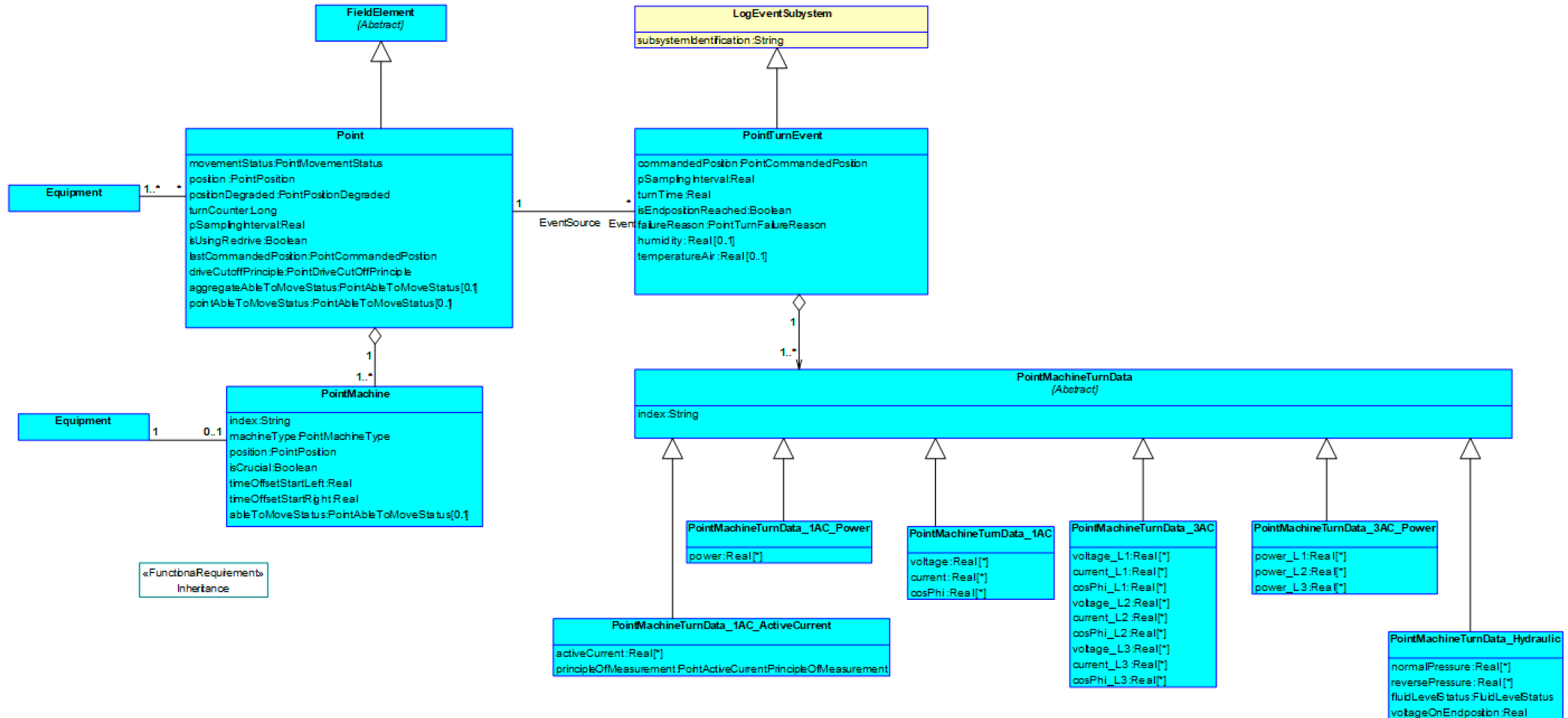
We standardize the Description, not the system architectures!

Is a switch ready to operate?



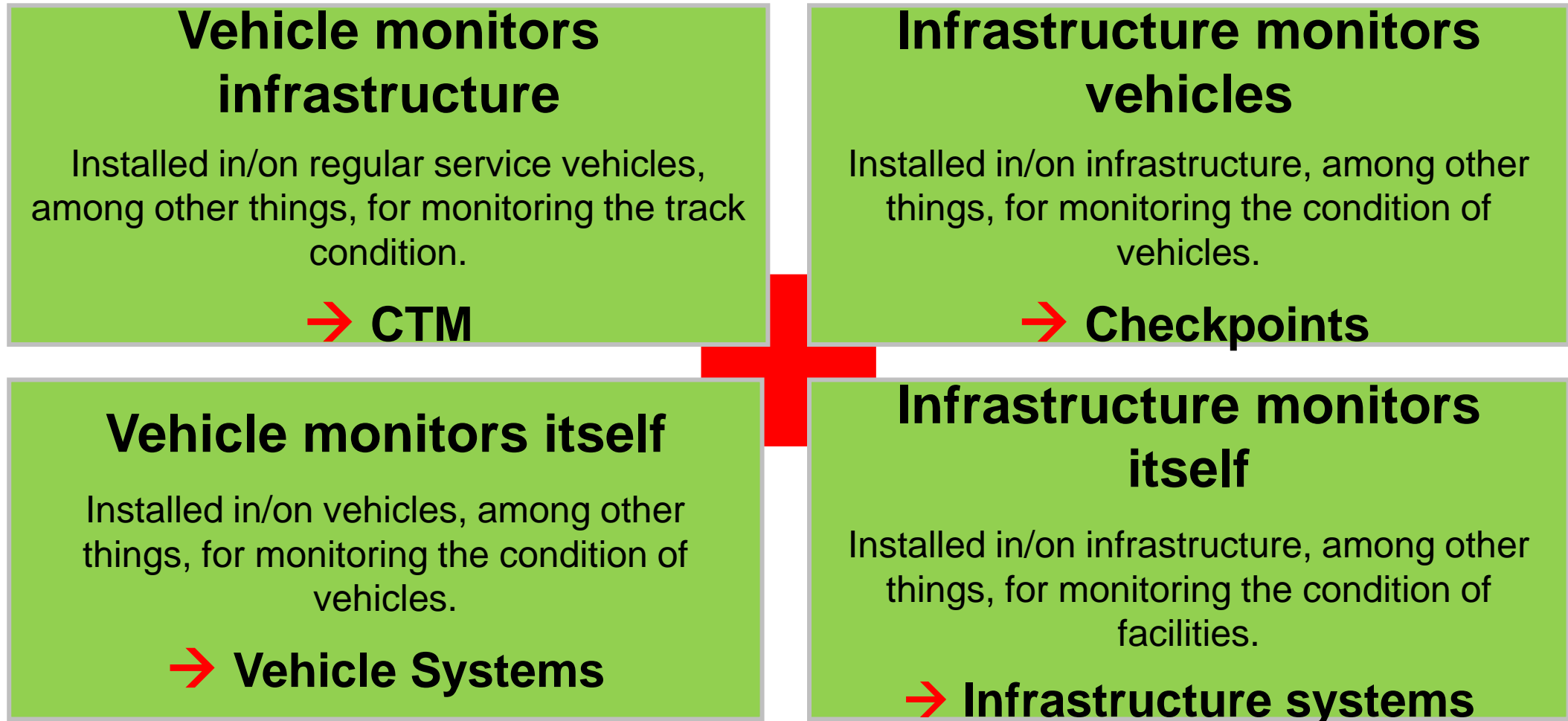
Ready for Operation?

"logical" Product Group Model





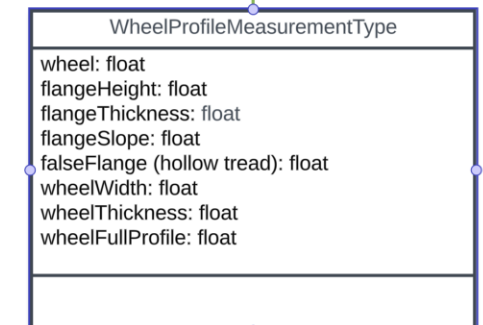
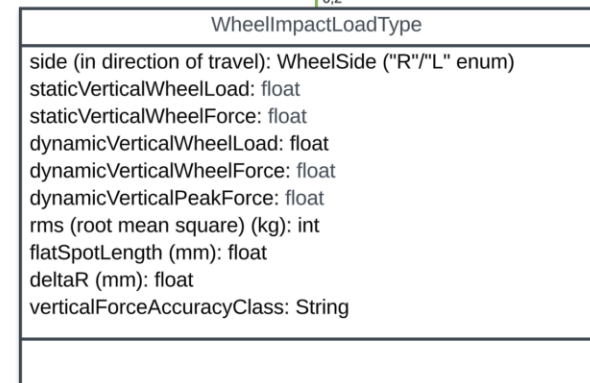
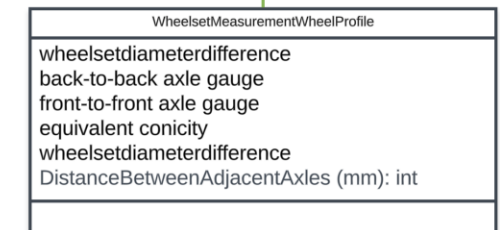
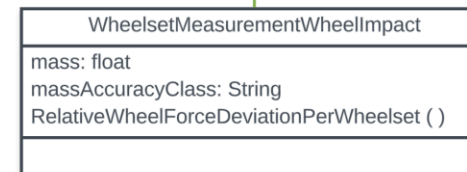
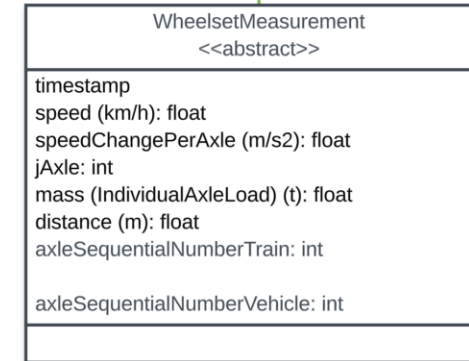
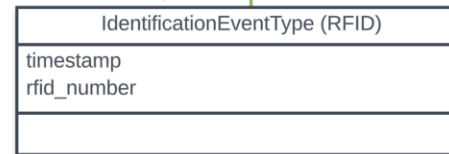
We need Product Group models in different “quadrants” of the railway sector



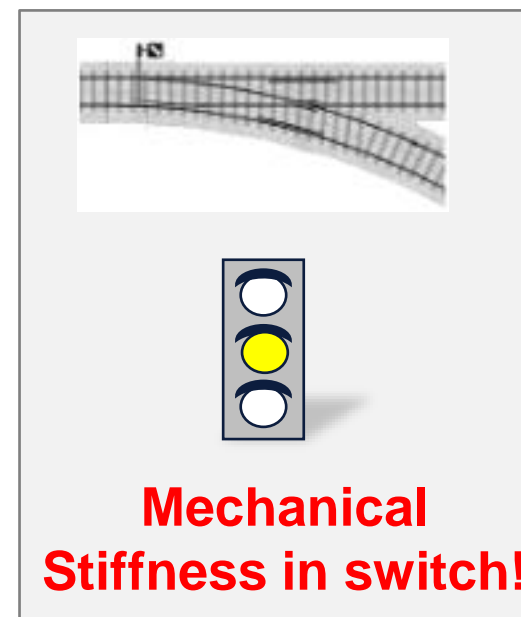
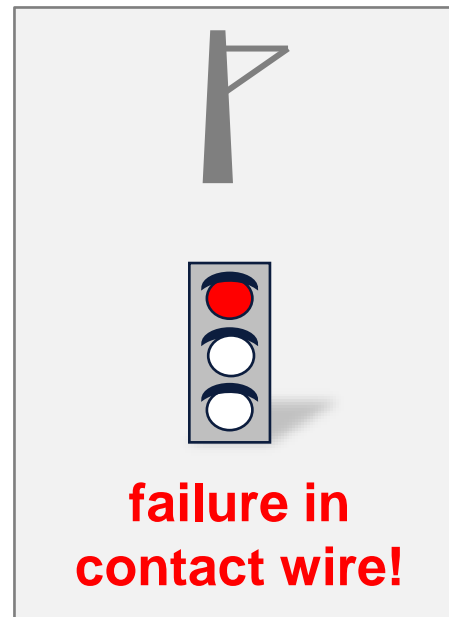
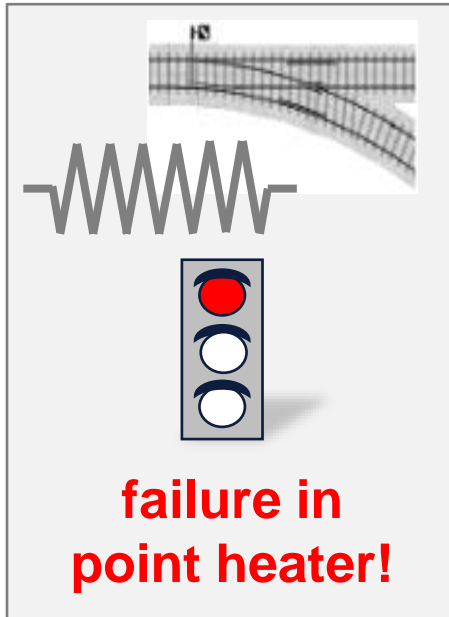
Infrastructure monitors vehicles: Checkpoint Models



Source: <http://international-engineering.com/en/divisions/monitoring-division/Wheel-Imp>



Failure Scenario: What is happening here? Where to go?

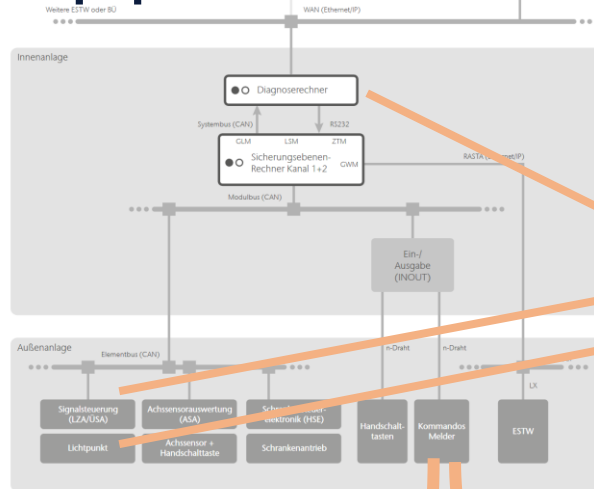


Source: DB InfraGO, Grassmann, 2015

How many systems must function correctly (logical “AND”) for a route to be set in a railway signaling system?

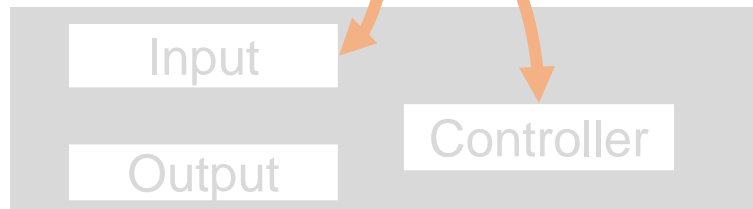
References: Equipment “implements” the “ProductGroup-XX”

Equipment



Source <https://www.scheidt-bachmann.de/systeme-fuer-signaltechnik/produkte-loesungen/bahnuebergangstechnik/bahnuebergangssteuerung/> am 25.02.2020

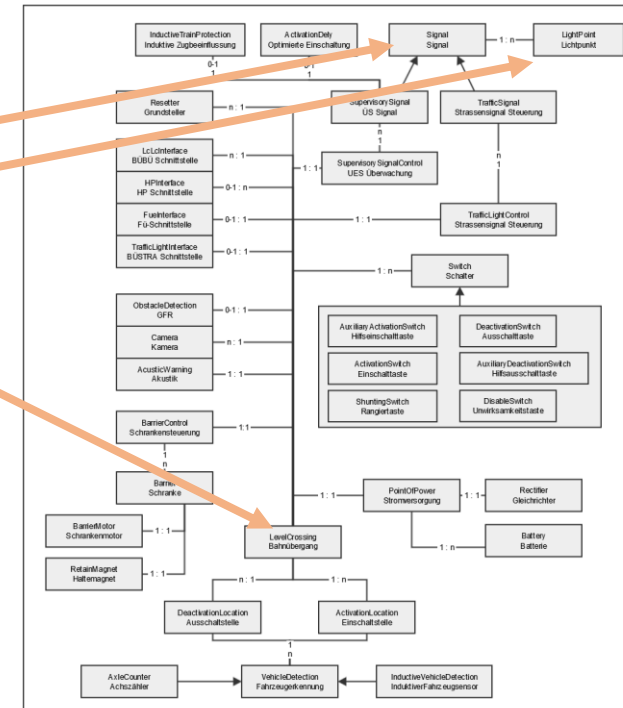
Child Equipments



HasComponent

Implements

Product Group



Source: DB InfraGO, 2016

MORE:

IsPartOfRedundancyGroup
ProvidesPowerTo, ...



Tactical User Stories

As a maintenance planner,

I want access to standardized, condition-based and prognostic asset data

to optimize maintenance planning and dynamically prioritize actions based on environmental and functional context.

Key Needs:

- Comparable Centralized Condition data and fault prediction
- Functional dependencies for impact-based prioritization



Strategical User Stories

As a procurement or asset planning stakeholder,
I want standardized, vendor-independent performance and availability data across assets
to make informed decisions in procurement, migration, recall campaigns, and claims management.

Key Needs:

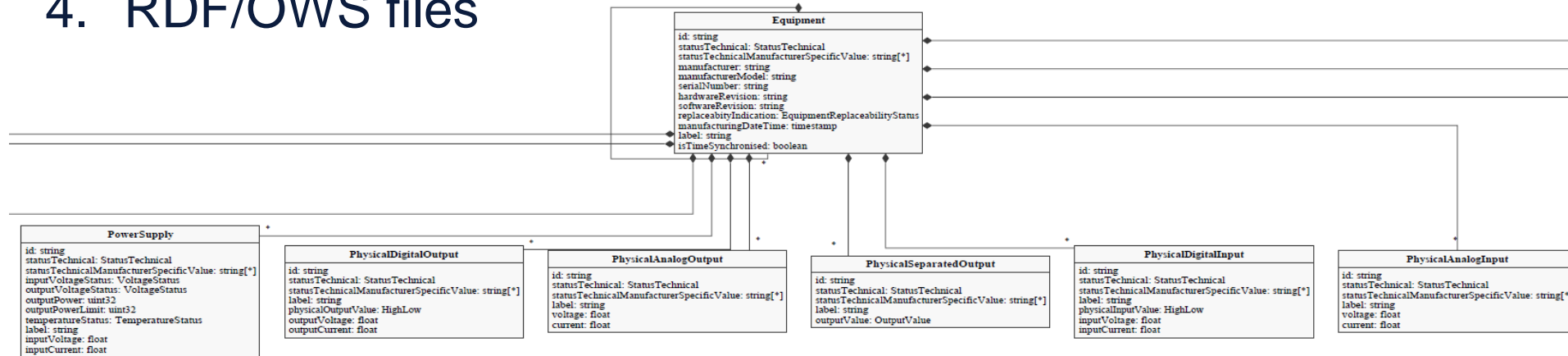
- Comparable availability and performance metrics
- Device and component model consistency
- Centralized inventory (current and historical)
- Dependency visibility and traceability



We scale: SDI-XX Toolchain for Product Group Models

The Toolchain generates the following Artifacts:

1. UML class diagram
2. Meta Information table as an excel sheet.
3. OPC UA Information Model as a NodeSet2 XML format
4. RDF/OWS files



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
ID	Type	ReqID	Requirement	Where	Req Type	Context Type	Context Category	Temporal Accuracy	Sampling Frequency	Data Collection Interval	Data Buffering Time	New Data Measurement Time	New Data Transfer Latency	
1	Req	1	Point	The class represents the Subsystem - Point.	PointMovementStatus	1.1.1	Diagnosis	Operation	1	0.001	1	10	1	
2	Req	2	MovementStatus	Reports the movement status of the point.	PointPosition	1.1.1	Diagnosis	Operation	1	0.001	1	10	1	
3	Req	3	Position	Reports the position of the point.	PointPosition	1.1.1	Diagnosis	Operation	1	0.001	1	10	1	
4	Req	4	PositionReported	Reports the reported point position.	PointPositionReported	1.1.1	Diagnosis	Operation	1	0.001	1	10	1	
5	Req	5	PointMovementStatus	The number of point machine movement since the last event.	PointMovementStatus	1.1.1	Diagnosis	Operation	1	0.001	1	10	1	
6	Req	6	PointPosition	The last position measurement in the PointMovementStatus.	PointPosition	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
7	Req	7	PointPositionReported	Reports the last position measurement at the point by the infrastructure.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
8	Req	8	PointPositionReported	Reports whether the point was, individual drive or common drive as valid or invalid.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
9	Req	9	PointPositionReported	Reports the aggregated ability to move status, considering the ability to move of the Subsystem - Point and all the configured Point Machine.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
10	Req	10	PointPositionReported	Reports the ability to move status of the current lane of the Subsystem - Point.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
11	Req	11	PointPositionReported	Time that defines the maximum time period the Point has to return to its final position, starting with the command sending to the point machine.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
12	Req	12	PointPositionReported	Operational identifier of the connected subsystem.	PointPositionReported	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
13	Req	13	PointMachine	Identifies a point.	PointMachine	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
14	Req	14	PointMachine	Index of a point machine.	PointMachine	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	
15	Req	15	PointMachine	Index of a point machine.	PointMachine	1.1.1	ConfigurationParameter	Measurement	1	0.001	1	10	1	



Areas for Cooperation

```
<?xml version="1.0"?>
<rdf:RDF xmlns="http://rail-research.europa.eu/eu-rail.sdi-generic.4.3.1-r02/equipment#"
  xml:base="http://rail-research.europa.eu/eu-rail.sdi-generic.4.3.1-r02/equipment"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
```

Long lasting namespace names, Downloadable

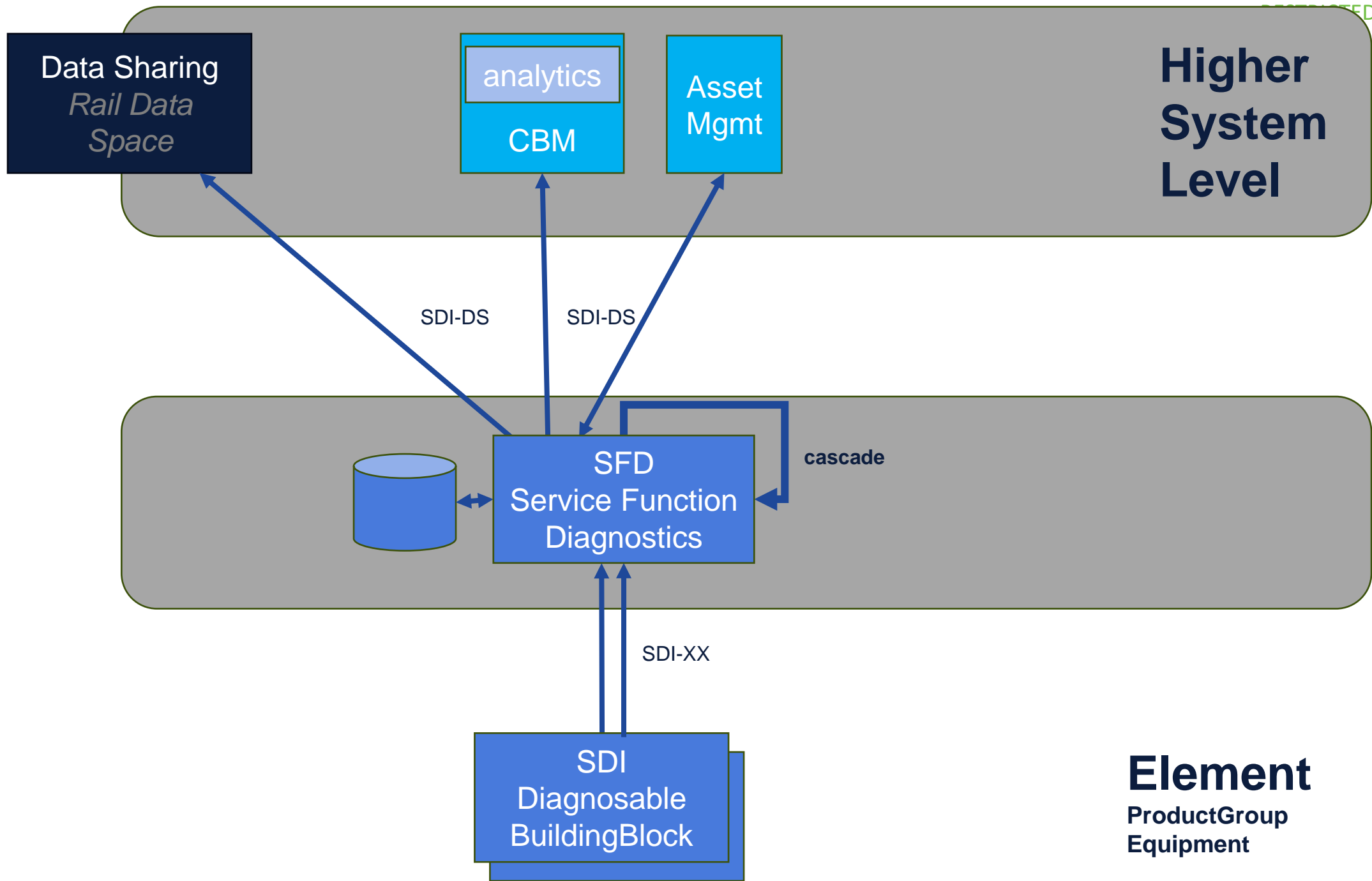
```
<!-- Core Classes -->
<owl:Class rdf:about="#Equipment"/>
<owl:Class rdf:about="#PowerSupply"/>
```

Class Names in ProductGroup Models

```
<owl:Class rdf:about="#Subsystem"/>
<owl:Class rdf:about="#Switch">
  <rdfs:subClassOf rdf:resource="#Subsystem"/>
</owl:Class>
```

```
<!-- Functional reference relationship -->
<owl:ObjectProperty rdf:about="#implements">
  <rdfs:domain rdf:resource="#Equipment"/>
  <rdfs:range rdf:resource="#Subsystem"/>
  <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
  <rdfs:comment>
    Indicates that a physical Equipment implements a logical Subsystem such as a Switch.
  </rdfs:comment>
</owl:ObjectProperty>
```

Functional References Naming





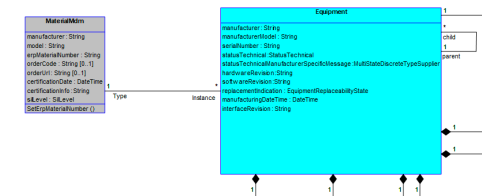
The railway operator (User) has right to access, use and share the data

What data?

- **Condition data** of physical and logical components
- **Usage and performance metrics**
- **Fault and repair records**

With whom? Suppliers, integrators, maintenance providers

Why? improve products, innovation





We need secure, sovereign and standardized data sharing across trusted partners

INTERNATIONAL DATA SPACES ASSOCIATION

JOIN IDSA →

European Rail Data Space



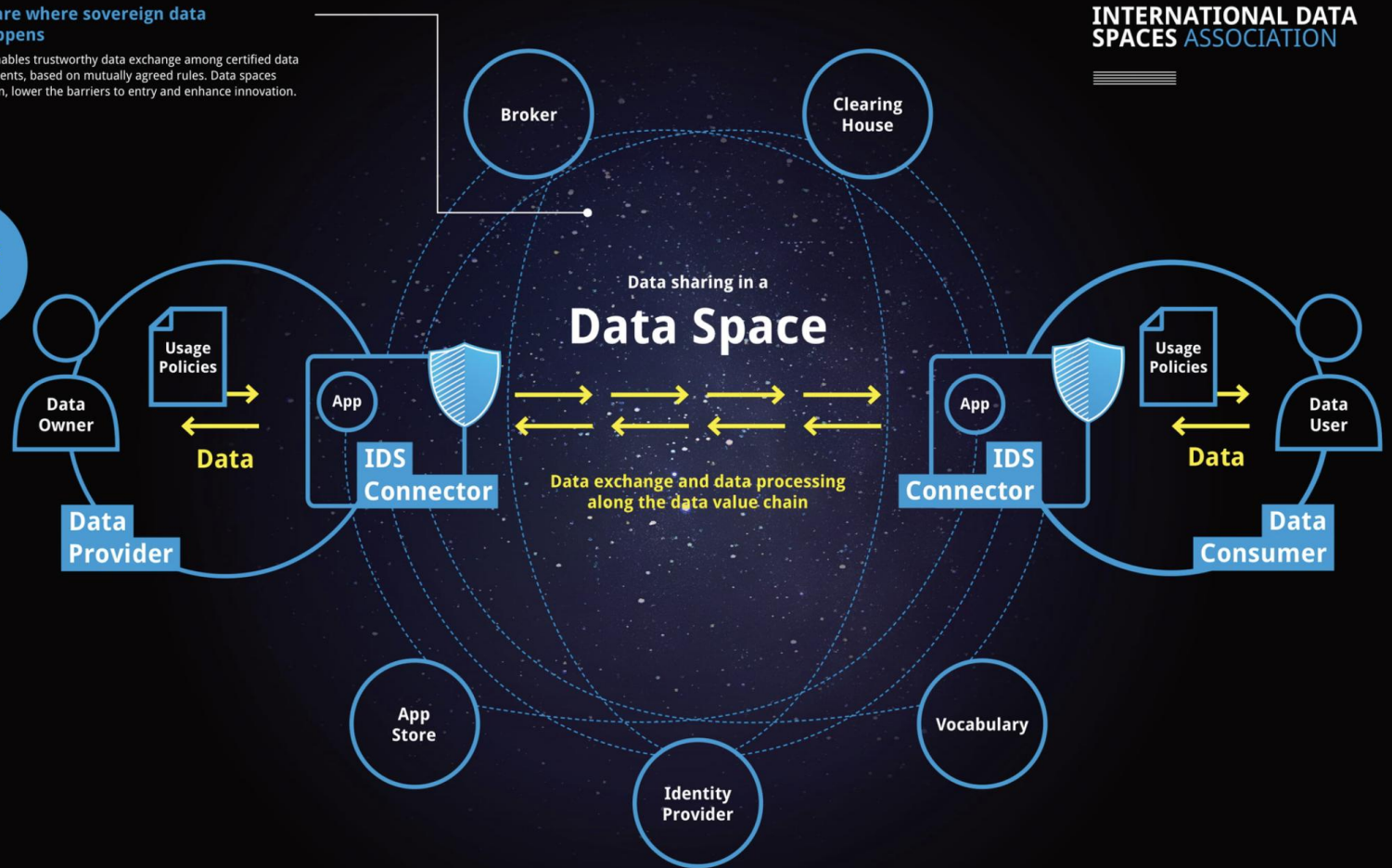
Europe's entire rail community is joining forces to create a data ecosystem for the track. Watch out – it's fast!



Data spaces are where sovereign data exchange happens

The IDS standard enables trustworthy data exchange among certified data providers and recipients, based on mutually agreed rules. Data spaces improve cooperation, lower the barriers to entry and enhance innovation.

Discover the data space elements by mouseover.



INTERNATIONAL DATA SPACES ASSOCIATION

Service Function Diagnostics
& Data Sharing

Thank you for Listening!

Prof. Dr. Karl-Albrecht Klinge

