Tackling Materials and Manufacturing Innovation Challenges with Digitalised Translation – from conceptualisation to ontology

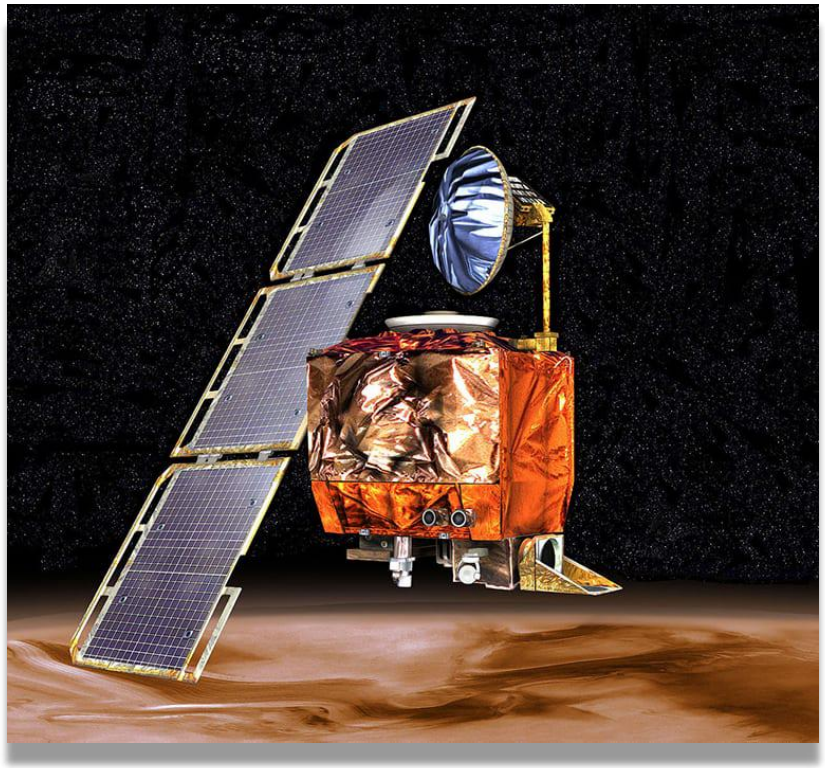
September 23rd, 1999

Mars Climate Orbiter: Orbit Insertion

Upon attempted orbit insertion, the spacecraft breached its minimum safe altitude and was forever lost to the cosmos.

Thruster Control → (Total Impulse) → Trajectory Control

Pound-force seconds ≠ Newton seconds

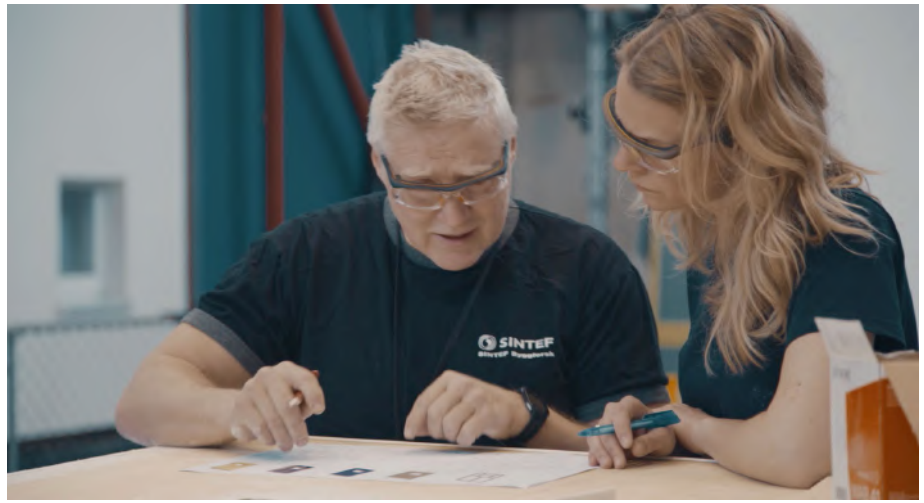


Thruster Control and Trajectory Control Software were not ***Interoperable***

The Trajectory Control did not understand the ***Meaning*** of the data

Communication: people vs machines

For communication between people it is the responsibility of the sender to ensure that the message is understood



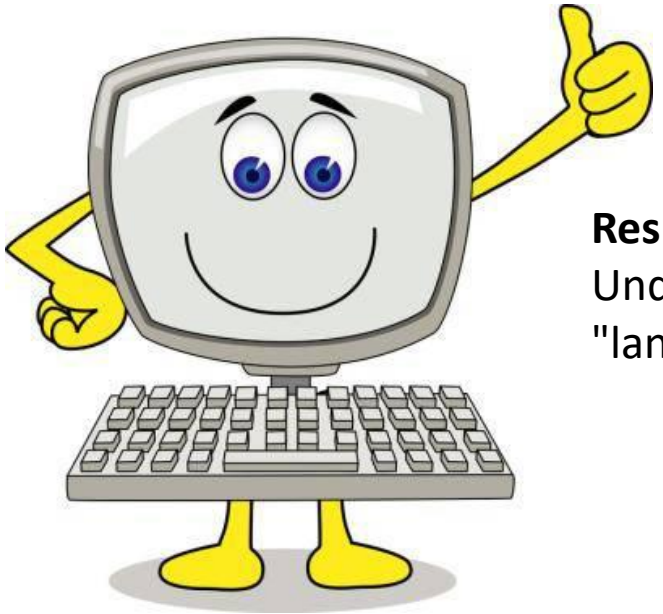
For communication between machines it is traditionally the receiver that has the responsibility to understand the message

Semantic interoperability puts more responsibility on the sender – like for people

Ontology
Common reference framework

Responsibility:
Communicate semantically

message



Responsibility:
Understand the "language"

Semantic interoperability

Simplify sharing of materials data

Semantic interoperability

Hide the complexity of interoperability operations

Communicate **unambiguous** information between computer systems

Improve **reusability**, **discoverability** and **accessibility** of **interoperable information**

Enabling interoperability between characterisation and modelling using EMMO

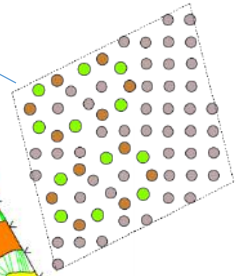
Triplestore
Ontology + knowledge graph

Eva Mørtsell
TEMOperator
Operator

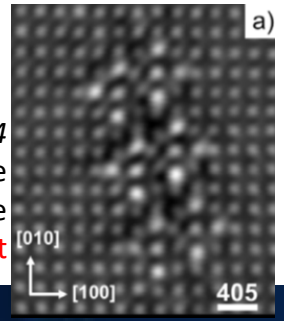
The ARM at Nanolab, NTNU
DoubleCorrectedTransmissionElectronMicroscope
TransmissionElectronMicroscope
MeasurementSystem

node_324@stallo
ComputationNode
Participant

Jesper Friis
DFTModeller
Modeller



Al-GP zone interface model n .13
StructureModel
Model

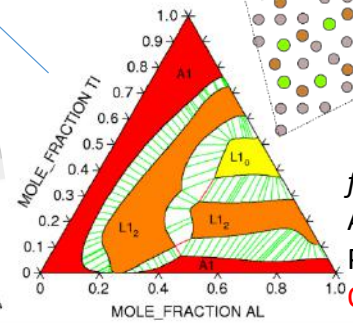


img00023.md4
HAADFImage
Image
MeasurementResult

HyperSpy rev. a3b3a2
HyperSpy
Software

```
if (!(arr = calloc(1, asize))) r
arr->dims = (size_t *)((char *)a
arr->strides = (int *)((char *)a
```

Rev. 34ec18
ScikitLearn
DataBasedModel



fstp://ntnu.no/~friisj/pd/Al-Li-Ti_600K.png
AlLiTiPhaseDiagram
PhaseDiagram
QuantitativeModellingProperty

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hasOperator

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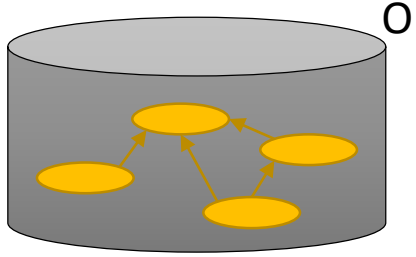


node_324@stallo
ComputationNode
Participant

DFT calculation
Modelling
Process

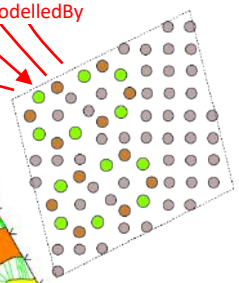
hasParticipant
hasParticipant
hasParticipant

GP zone
Structure
Sign

hasProcessInput
computedOn
modelledBy

Jesper Friis
DFTModeller
Modeller

acquiredBy
hasInterpreter
referentFor
hasSign
hasSign
modelFor
modelFor
hasInterpreter
hasPart



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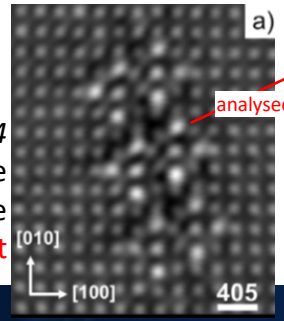

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analysedWith

HyperSpy rev. a3b3a2
HyperSpy
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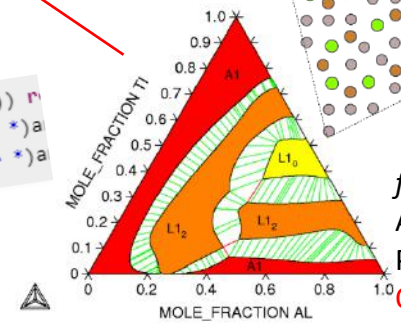

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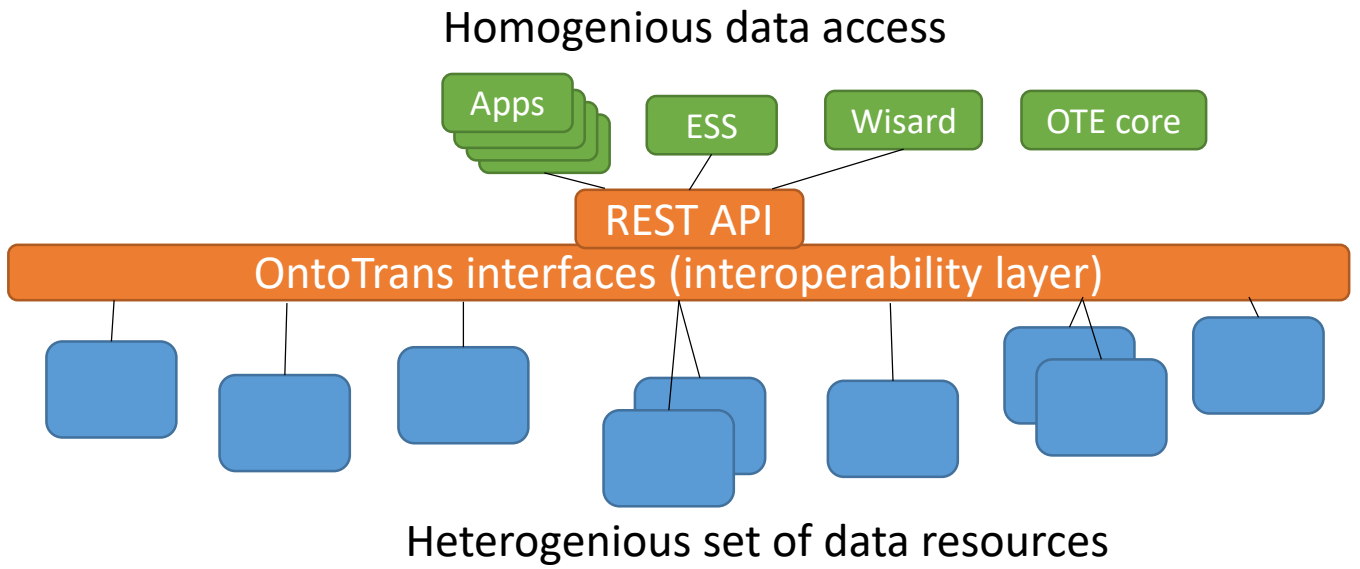
The implementation in OntoTrans

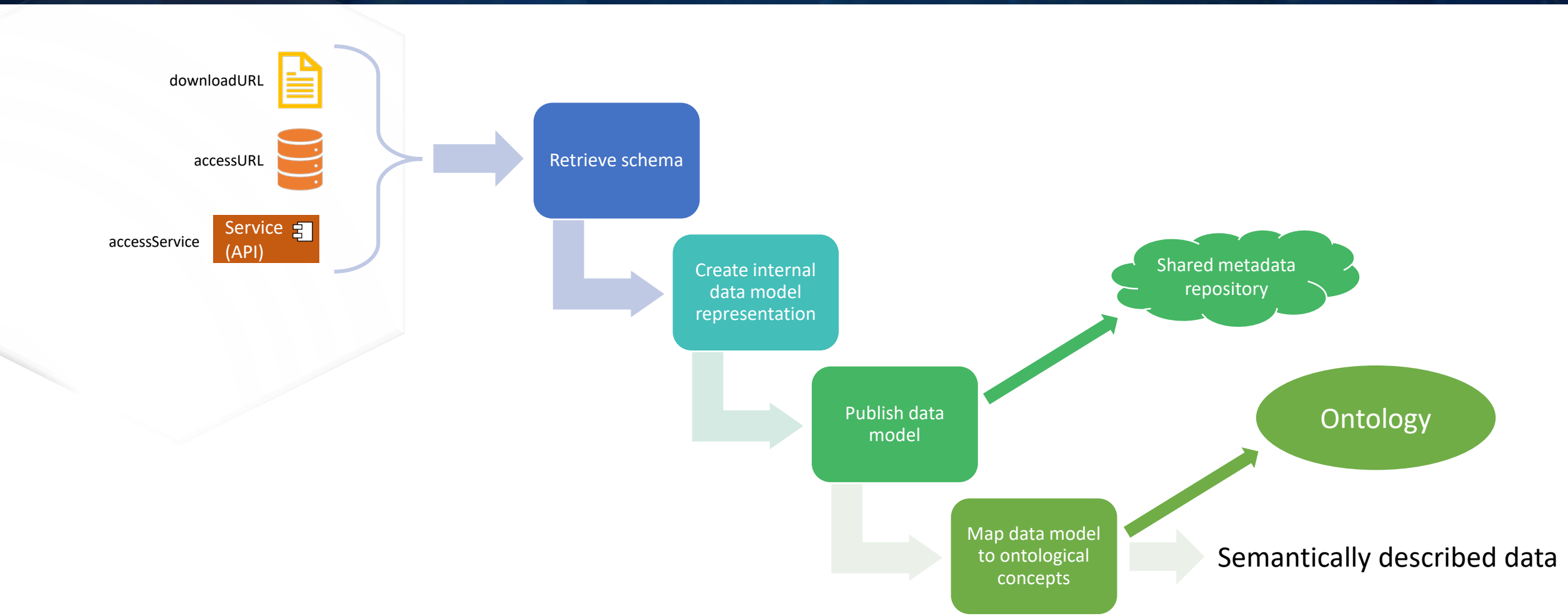
- Provide semantic interoperability
- Fast and simple onboarding of data resources
- Reduce hard dependencies
- Separation of concerns



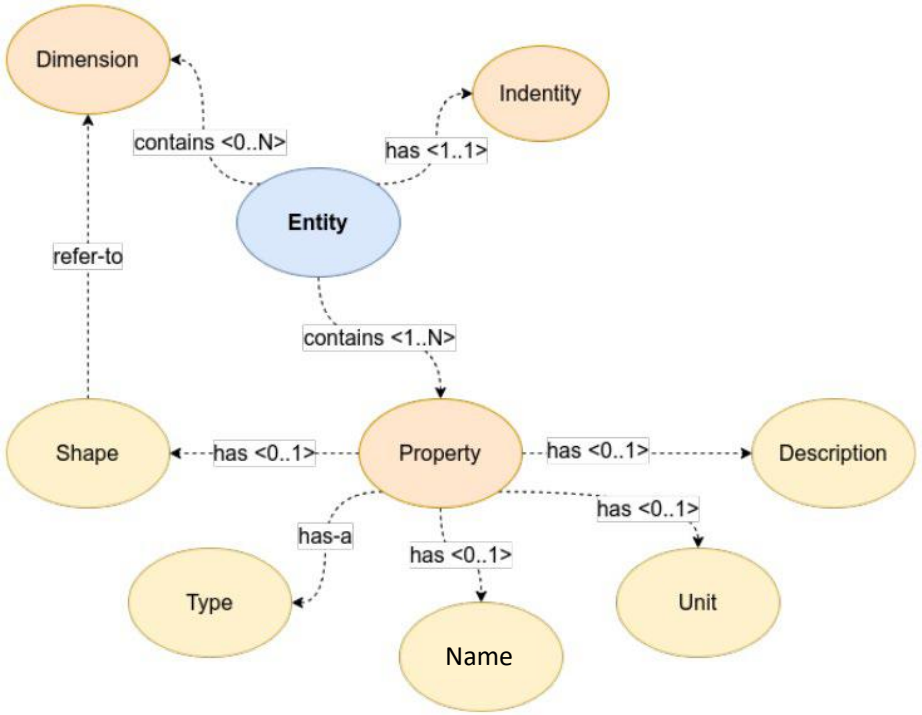
Software components

- OTEAPI – semantic REST API
- OTELib – python interface to OTEAPI
- SOFT7 – interoperability framework
- DLite – C implementation of SOFT

Connecting a data resource



Data model



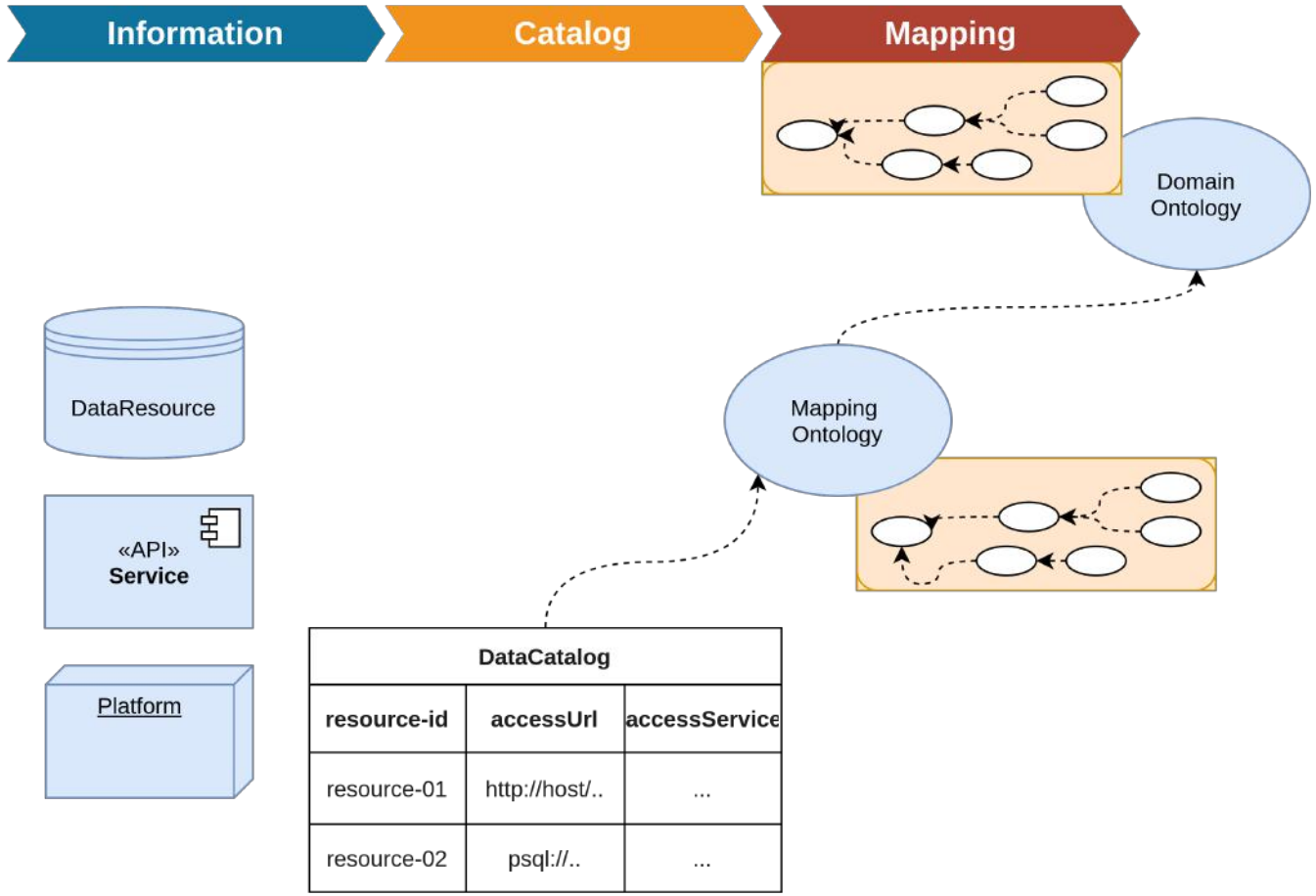
Entity (Metadata)	
URI	http://onto-ns.com/meta/0.2/MyEntity
Meta	http://onto-ns.com/meta/0.3/EntitySchema
Description	Human description of this entity…

Dimensions	
Name	Description
N	Human descr. of dimension N.
…	

Properties				
Name	Type	Shape	Unit	Description
Length	float64	["N"]	m	A length…
…				

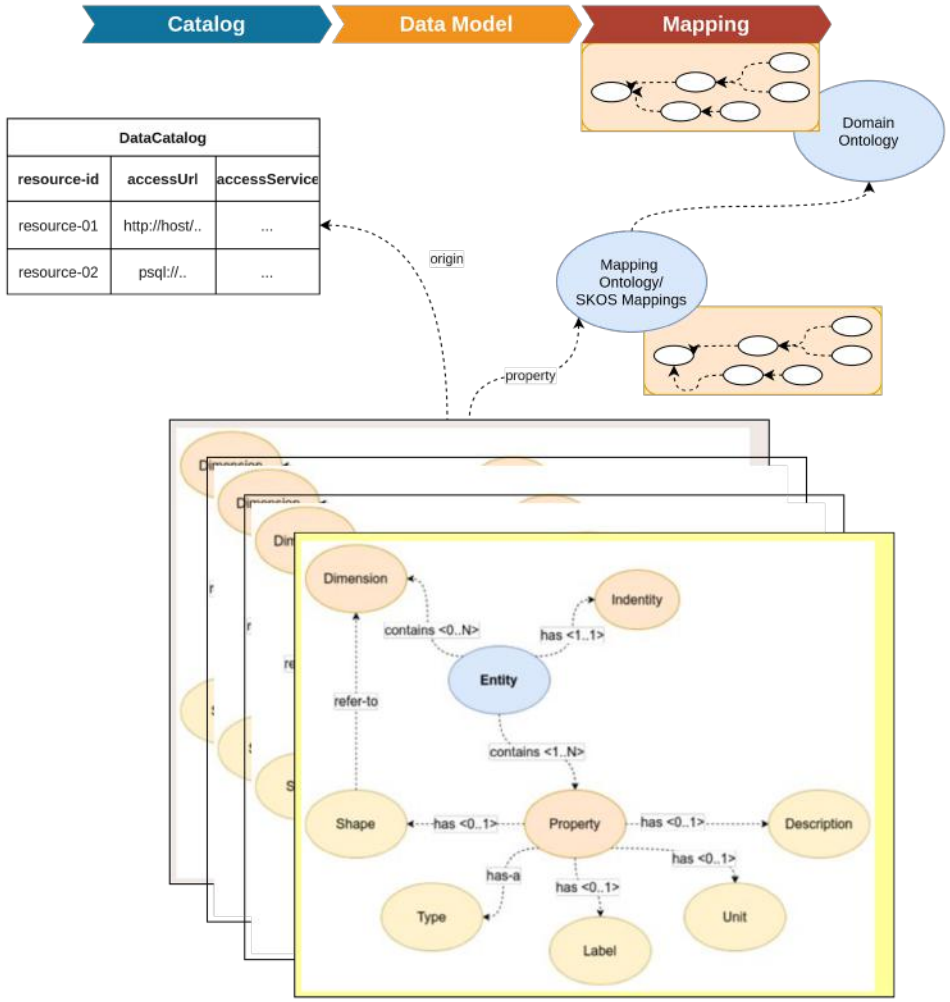
Merriam-Webster
Entity: *something that exists by itself : something that is separate from other things*

Data resource discovery



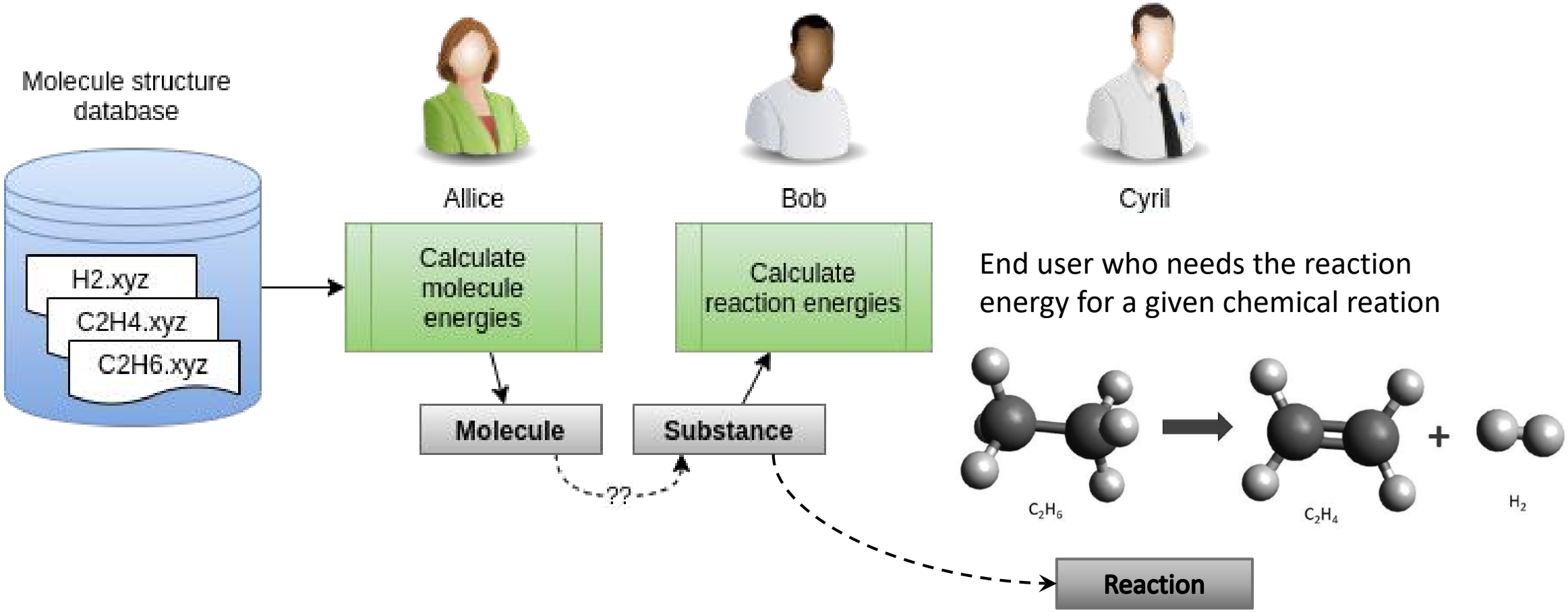
- A catalog of data can be used to **administrate connectivity information** to external resources
- A Mapping Ontology can be applied for **enriching DataCatalog entries with knowledge**
- Relevant resources can be found by querying the Knowledge Base (for instance using SPARQL).

Specific data set discovery



- Mapping Schema information from data sources onto Domain Ontology Concepts
- Allow for discovering datamodels based on concepts
- Allow for enriching datamodel properties
- Possible to create relations back to originating dataresources (i.e. Allowing to discover specific dataresource based on a set of quantities)

Transformations between data models



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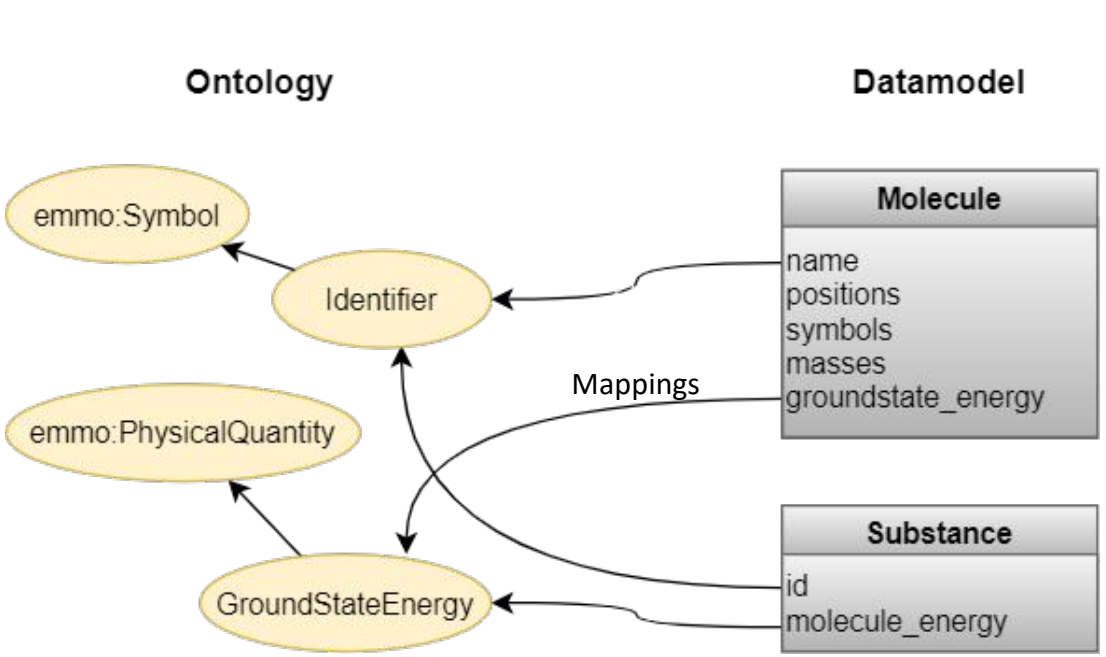

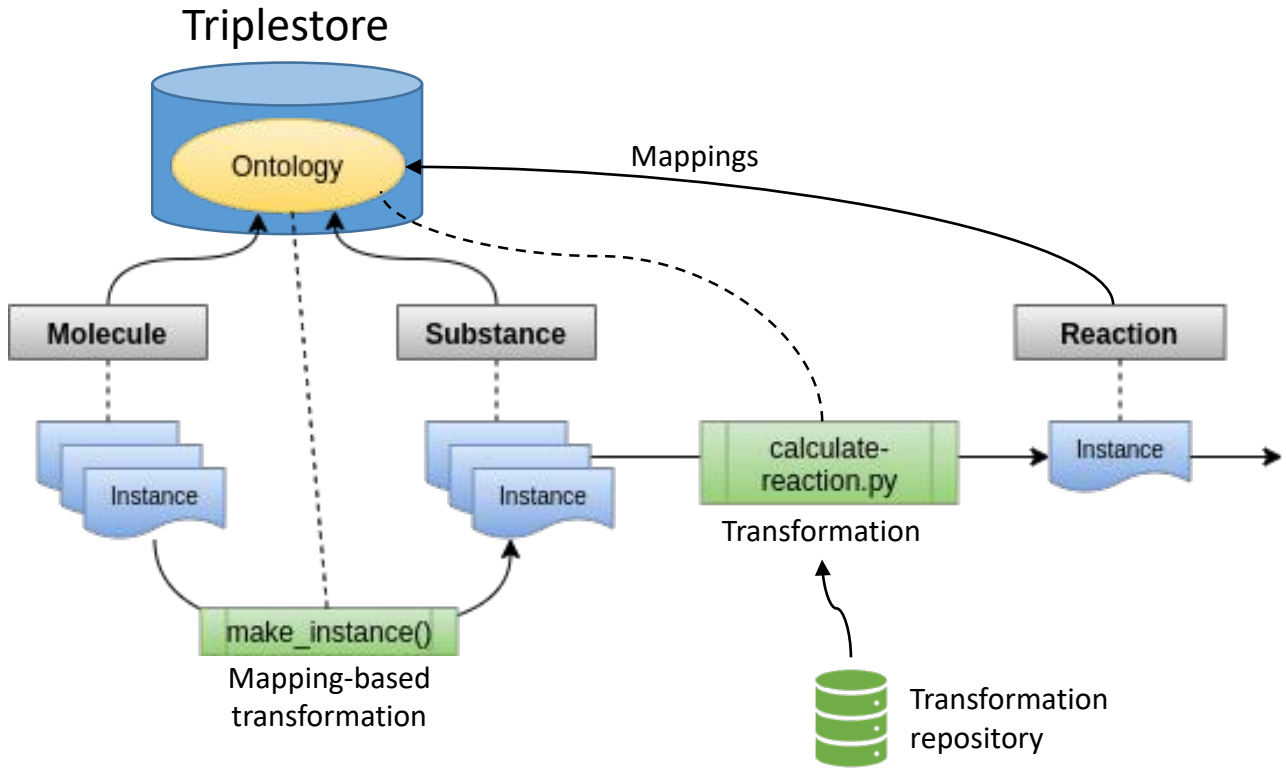

Thank you!

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