

Automated verification of measurement precision for Internet-of-Things equipment

W3C Web of Things Community Group 2023

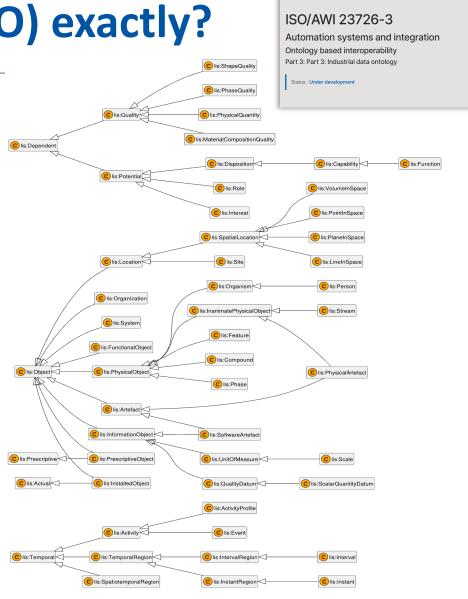
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Possibility in every drop

What is Industrial Data Ontology (IDO) exactly?

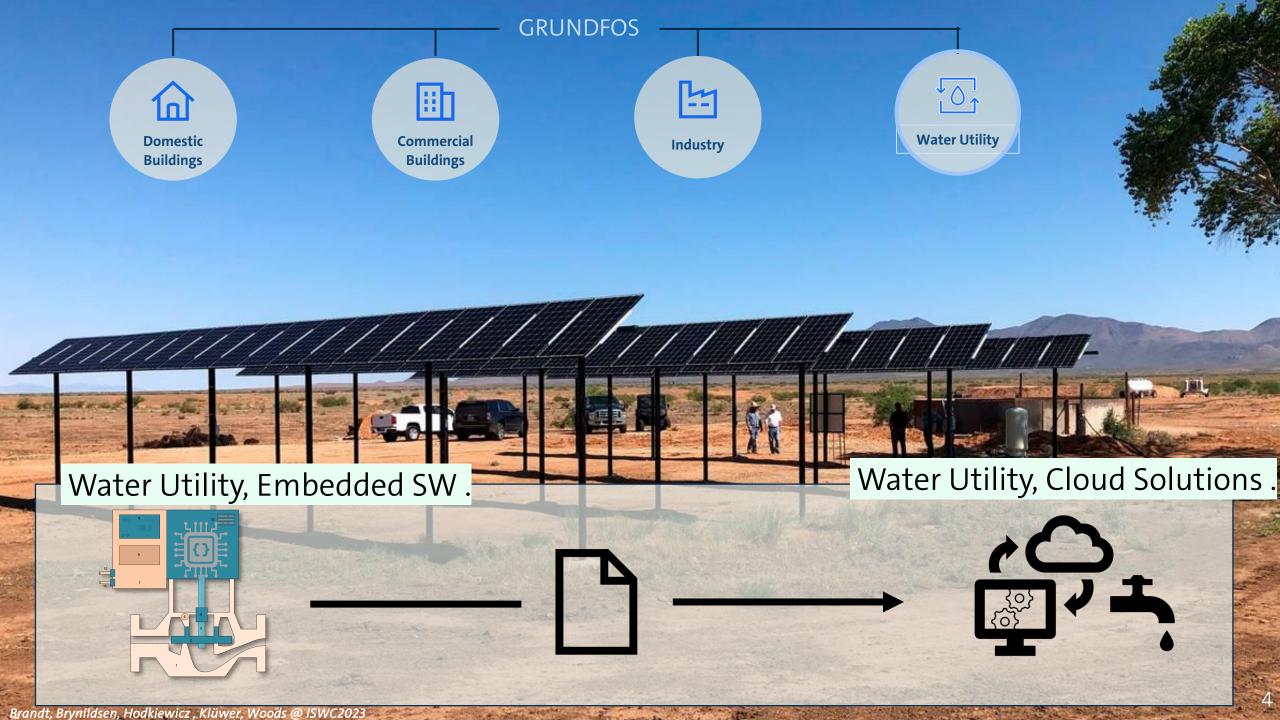
- ISO/AWI 23726-3 (IDO) is part of ISO/AWI 23726 (OBI) (Ontology-Based Interoperability) managed by ISO / TC 184 / SC 4 Industrial Data
- "An ontology for representing industrial data and information, building vocabularies and manage asset models that employ reference data libraries and exploit OWL reasoning"
- Derived from / inspired by
 - ISO 15926-2:2003
 - ISO/IEC 21838-2:2021 Basic Formal Ontology (BFO)
- Formulated in W3C's OWL 2 language
- Enables precise modelling
- 54 classes, 4 datatype properties, 88 object properties
- Developed and applied in Norwegian Energy (O&G) industry
- Formerly known as 'ISO 15926-14 Data model adapted for OWL2 Direct Semantics'



Standards About us News Taking part Store

IDO's concepts and relationships







IDO based model

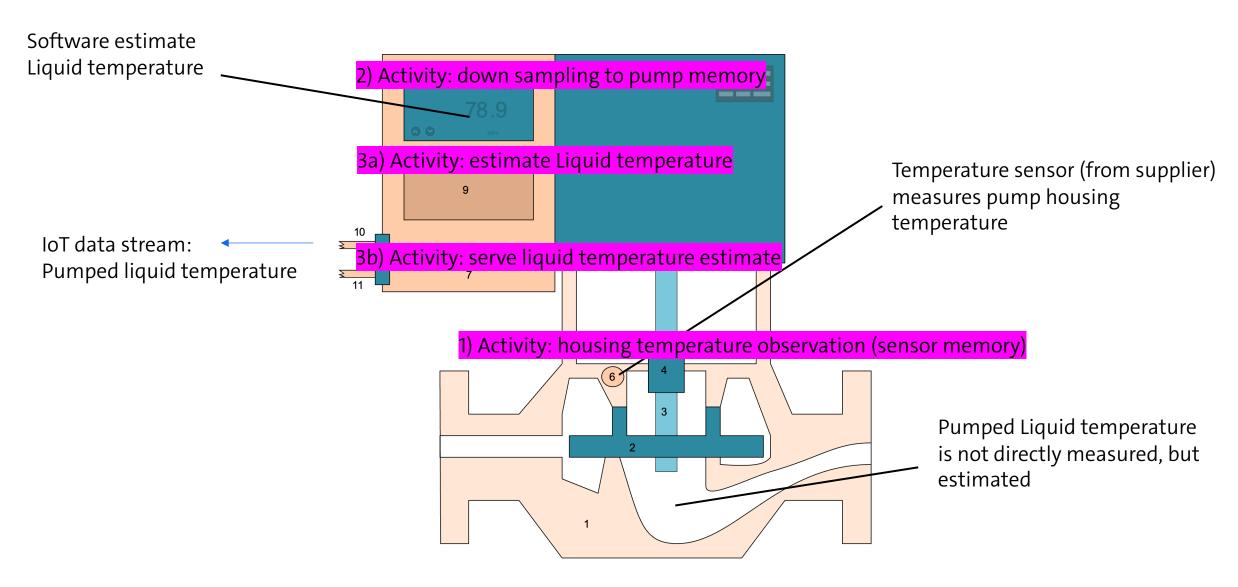


Goal:

- 1) Engineers document their engineering using standardized digital artifacts (SysML, UML, WoT, IEC/ISO 81346,...)
- 2) We can store and retrieve master data about what software is combined with what hardware for enterprise-size portfolio (~600.000 types of pumps).
- 3) Reuse RDF community released standardized IDO modelling patterns and reasoning modules for equipment, qualities and quality data (POSC Caesar Association (PCA)).
- 4) We want to minimize the amount of bespoke semantic analysis scripts being written.

IDO use case "Pump with firmware"





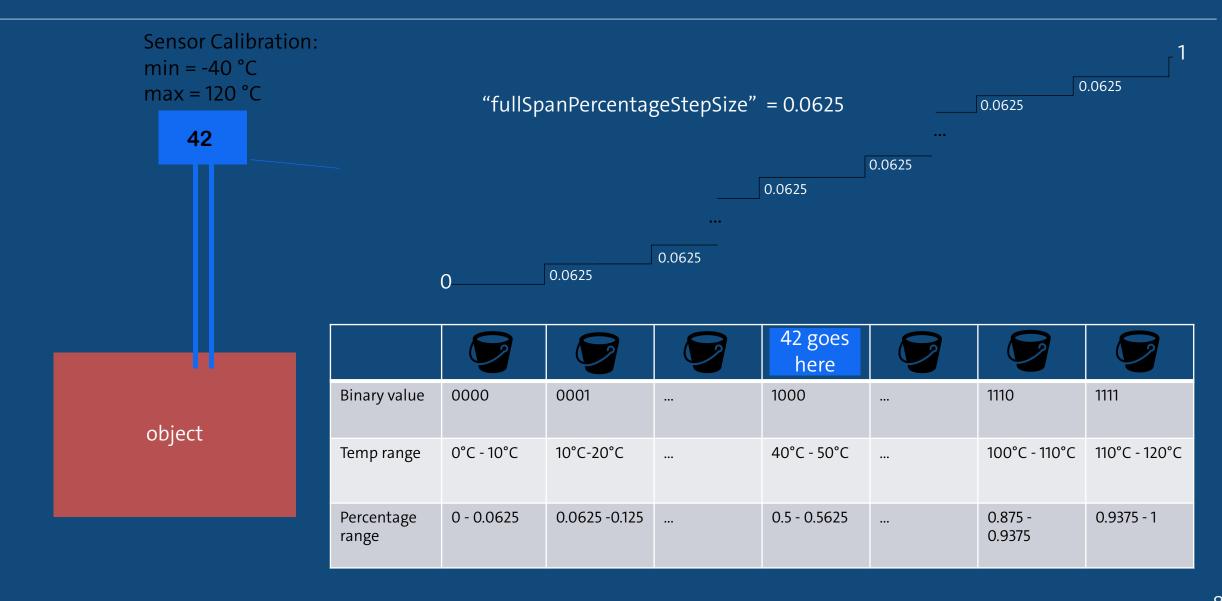
Data resolution





Data resolution





IDO based model WoT Standardized Information Handover



WoT Thing Description files

Standardized IoT profiles about pumps.

https://www.w3.org/WoT/

"The LIQUID_TEMP range is [-40, -39, -38, ..., 119, 120]

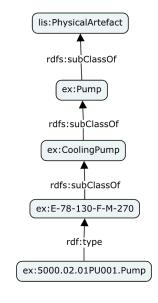
```
"@context": [
    "https://www.w3.org/2019/wot/td/v1",
        "acme": "https://www.acme.com/linkeddataserver/iotprotocol#",
        "assets": "https://www.acme.com/linkeddataserver/assets#",
        "unit": "https://www.gudt.com/unit#",
        "modbus": "https://www.w3.org/2019/wot/modbus#",
        "lis": "http://rds.posccaesar.org/ontology/lis14/rdl/",
        "ex:": "http://example.org/pumpwithfirmware"
"id": "assets:3ea24c16-afc2-4d61-af6a-2964d76f160a",
"@type": [
    "ex:E-78-130-F-M-270"
"title": "E-78-130-F-M-270",
"properties": {
    "acme:LIQUID TEMP": {
        "type": "number",
        "readOnly": true,
        "description": "Liquid Temperature",
        "lis:PhysicalQualtity": "ex:Temperature",
        "unit": "unit:DEG C",
        "minimum": -40.
        "maximum": 120,
        "multipleOf": 1,
         'forms":
                "href": "modbus+tcp://127.0.0.1:60000/1/40001?quantity=1",
                     "readproperty"
                "modbus:entity": "HoldingRegister"
```

Visual language

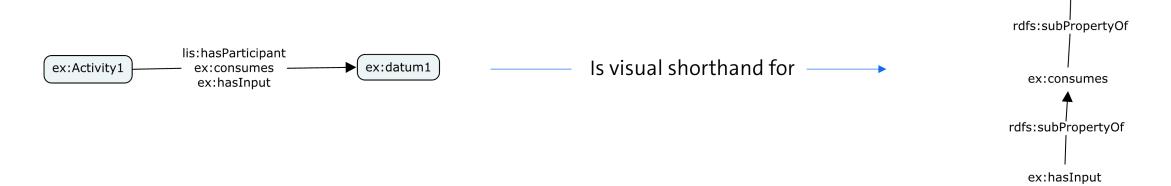


lis:PhysicalArtefact ex:Pump ex:CoolingPump ex:E-78-130-F-M-270 ex:5000.02.01PU001.Pump

Is visual shorthand for -



lis:hasParticipant



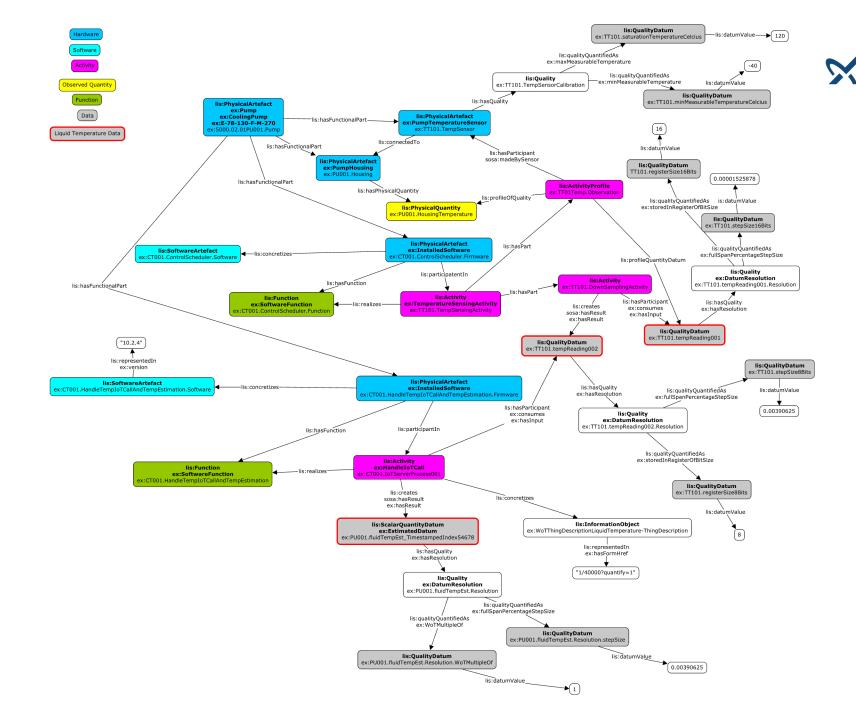
IDO use case

"Pump with firmware"

Based partly on patterns here:



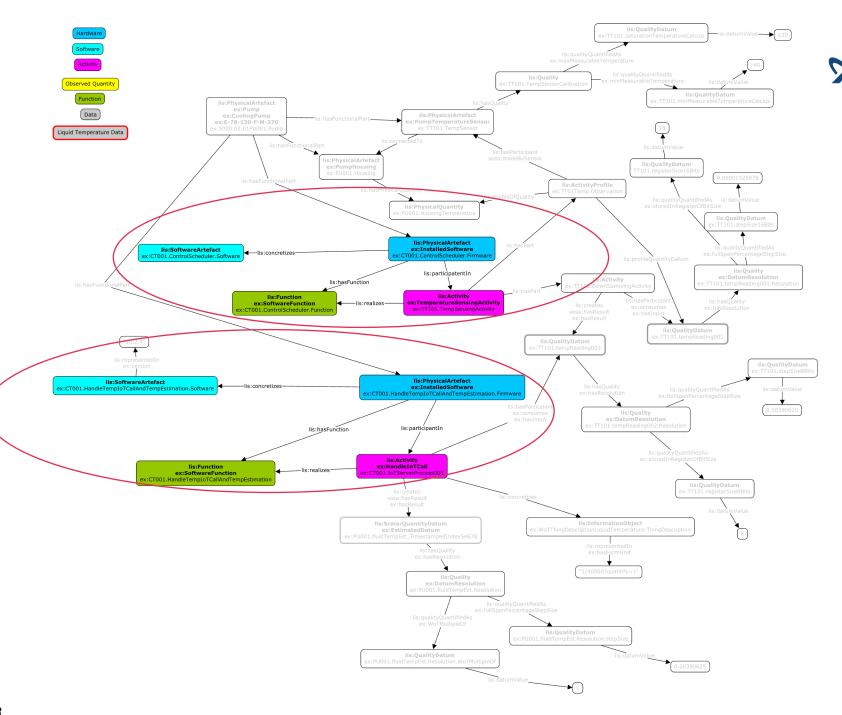
https://rds.posccaesar.org/doc/patterns/



IDO use case

• "Pump with firmware"

Installed Software pattern



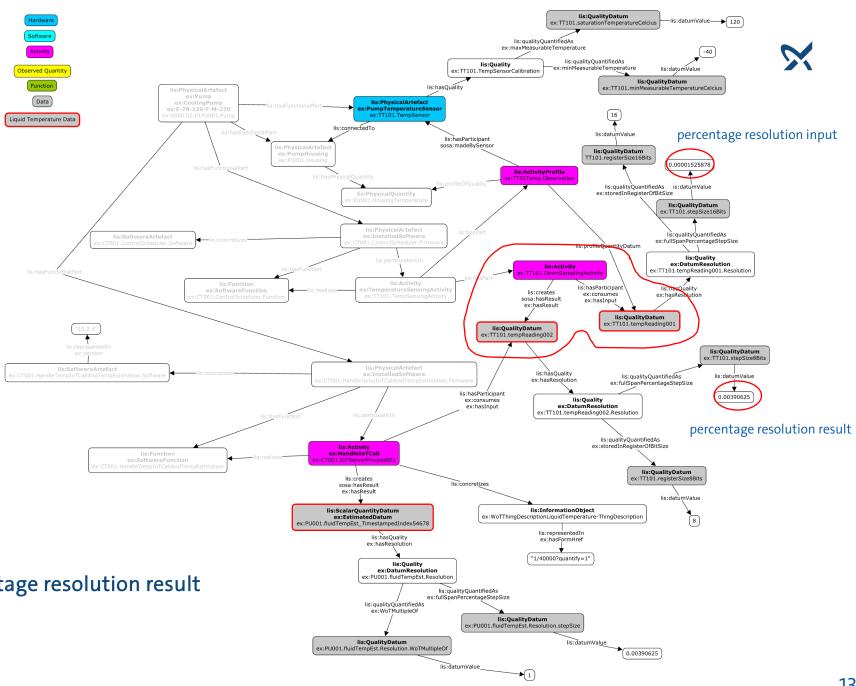
IDO use case

"Pump with firmware"

Validation

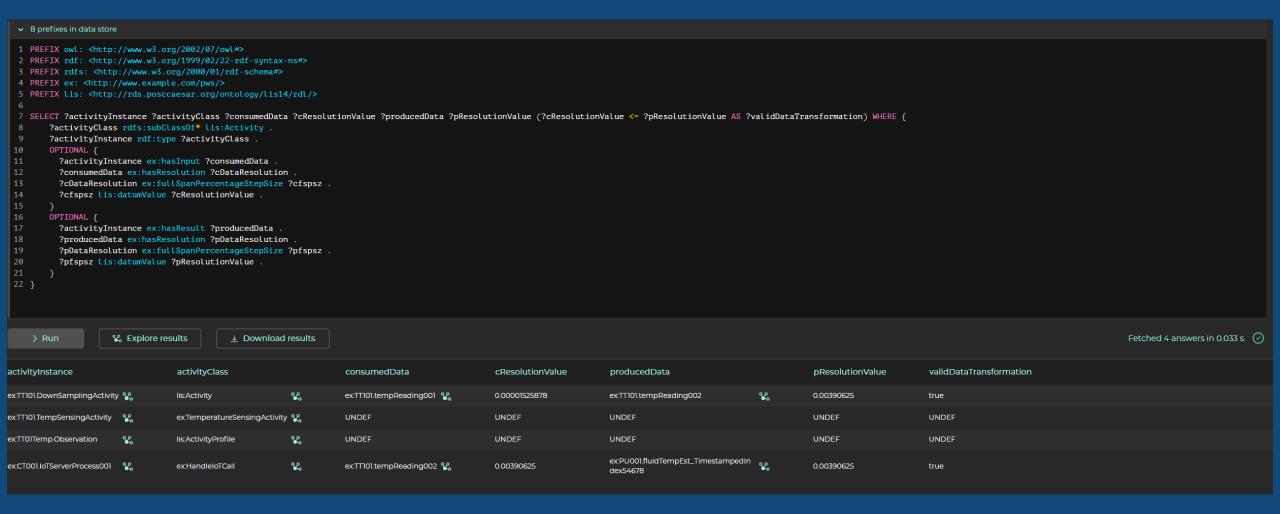
check that in data processing activities:

percentage resolution input <= percentage resolution result</pre>



Demo query





IDO based model, benefits





- 1) Digital offerings and the connectivity teams get standardized quality operating instructions (WoT TD Files) for IoT products on demand to produce digital offerings.
- 2) In product development: IoT Profiles of new and changed IoT products can be validated, on the combined HW+SW perspective.
- 3) The Enterprise can roll out hot-fixes and new IoT features to all digital offerings through a streamlined standards-based system.
- 4) The Enterprise can expand the information handover system to handle external manufacturers IoT operating instructions. The modelling is based on industry standards. IoT alliances can be build.

References



ISO/AWI 23726-3

https://www.w3.org/WoT/

https://rds.posccaesar.org/

Contact: mbrynildsen@grundfos.com

Thank you!



"IDO" iso.org page