

OPC UA for Machinery

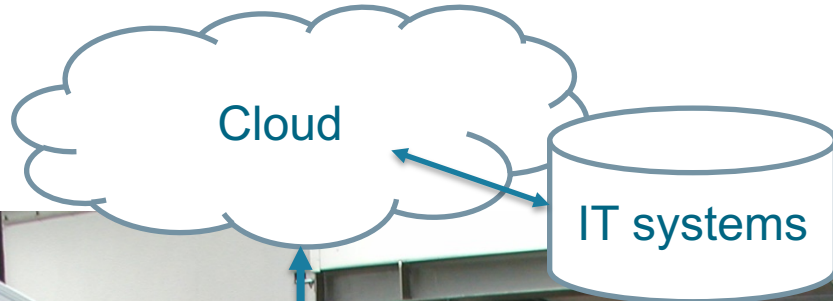
A base information model for machines



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Industrial Interoperability

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Vertical and horizontal networking

Involved components

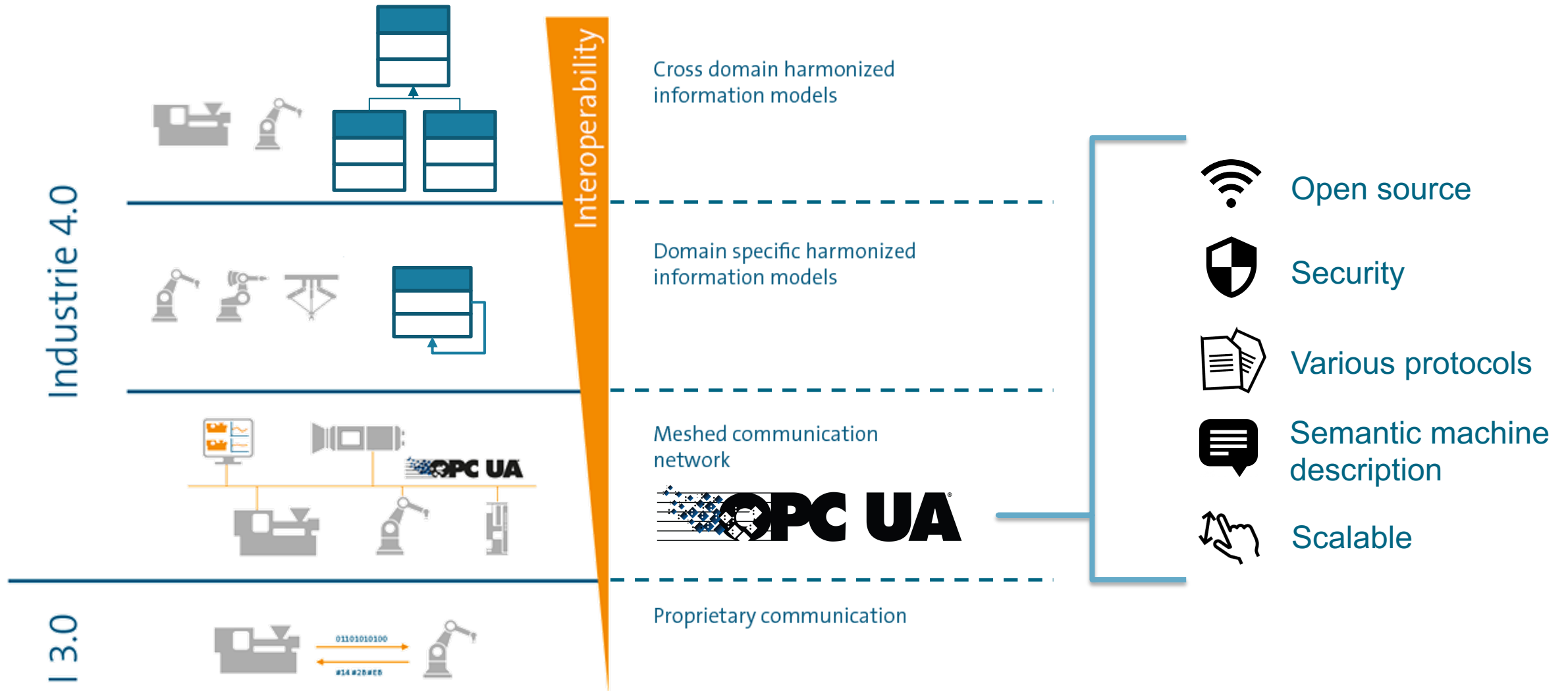
- » Robots
- » Industrial image processing
- » Gripper
- » Weighing Technology
 - On the conveyor belt
- » Electrical drive
 - In the robot
 - On the conveyor belt



Manufacturer-neutral interoperability in the industrial environment desired

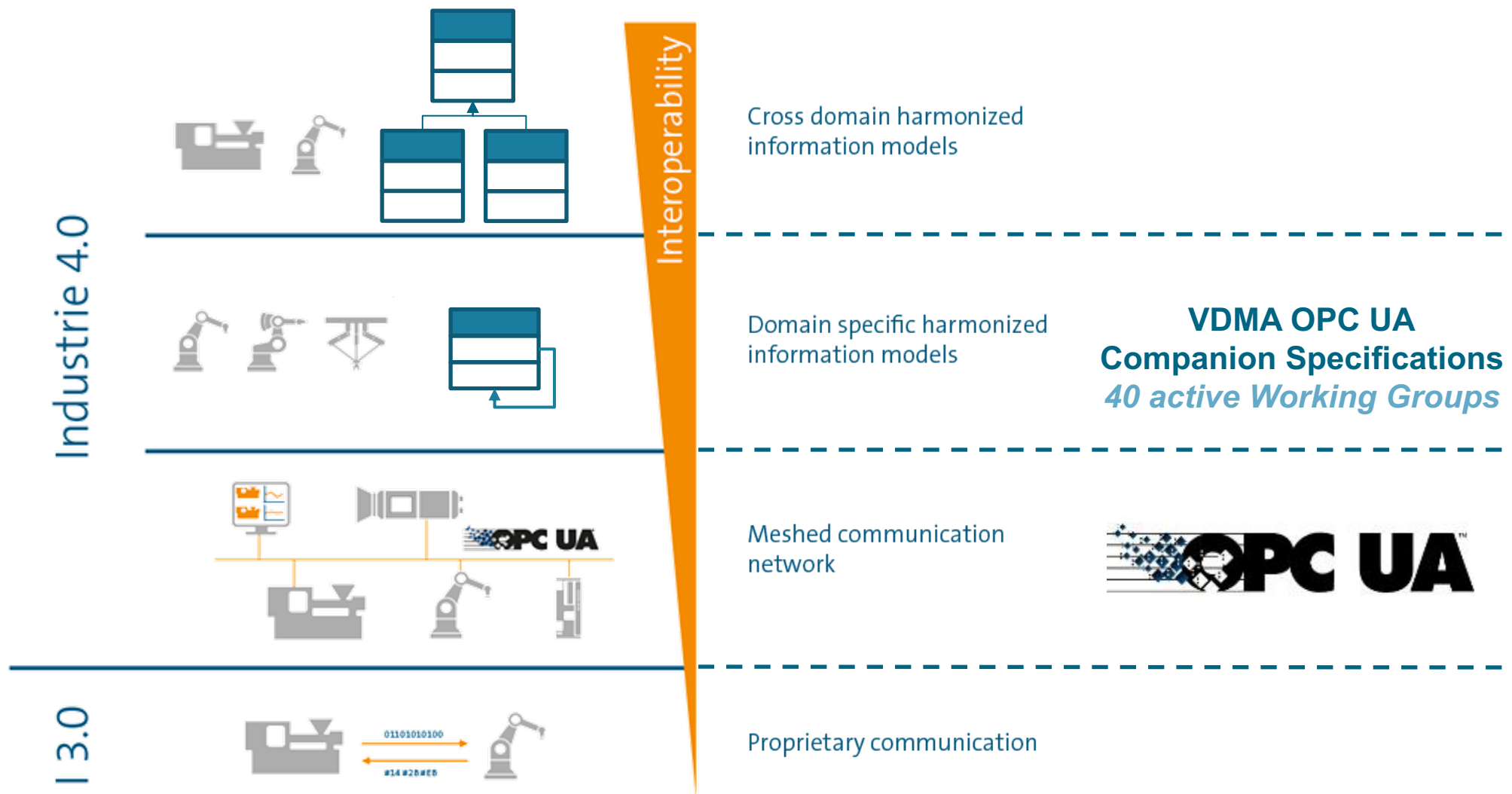


OPC UA serves as basis for the Global Production Language



Standardized Interfaces for specific Machines

OPC UA Companion Specifications next level of interoperability



Standardized Interfaces for specific Machines

OPC UA Companion Specifications next level of interoperability

- » Additive Manufacturing
- » Agricultural Machinery
- » Air Conditioning & Ventilation
- » Air Pollution Control
- » Automated Guided Vehicles
- » Battery Production
- » Building Control and Management
- » Building Materials
- » Ceramic Machinery
- » Cleaning Systems
- » Compressors, Compressed Air and Vacuum Technology
- » Construction Equipment
- » Continuous Conveyors
- » Cranes
- » Die & Mould
- » Drying Technology
- » Electrical Automation
- » Engines & Systems

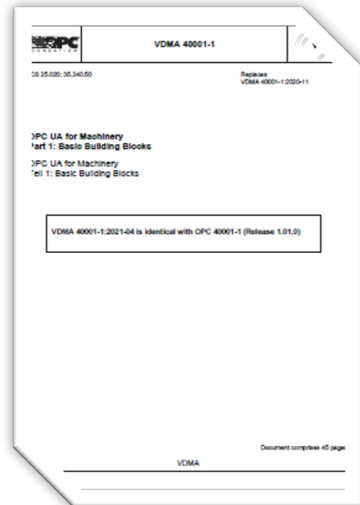
- » Fire Fighting Equipment
- » Fluid Power
- » Food Processing and Packaging Machinery
- » Foundry Machinery
- » Glass Machinery
- » Hydro Power Plants
- » Industrial Trucks
- » Integrated Assembly Solutions
- » Intralogistic Systems
- » Lasers and Laser Systems for Material Processing
- » Length Measurement Technology
- » Lifts & Escalators
- » Machine Tools and Manufacturing Systems
- » Machine Vision
- » Metallurgical Plants and Rolling Mills

- » Micro Technologies
- » Mining
- » Photovoltaic Equipment
- » Plastics & Rubber Machinery
- » Power Transmission Engineering
- » Precision Tools
- » Printing & Paper Technology
- » Process Plant & Equipment
- » Productronic
- » Pumps & Systems
- » Refrigeration & Heat Pump Technology
- » Robotics
- » Security Systems
- » Software & Digitalization
- » Surface Technology
- » Testing Technology

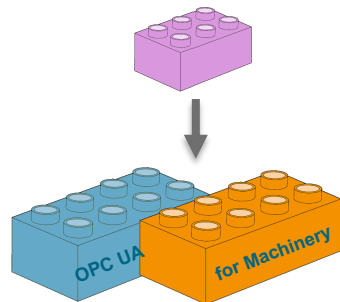
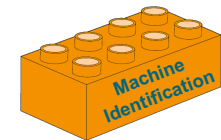
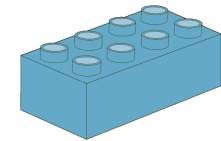
- » Textile Care, Fabric and Leather Technology
- » Textile Machinery
- » Thermal Power Plants
- » Thermo Process Technology
- » Valves
- » Waste Treatment & Recycling
- » Weighing Technology
- » Welding & Pressure Gas Equipment
- » Wind Power Plants
- » Woodworking Machinery

- » OPC UA CS released
- » Release Candidate
- » Joint Working Group with OPC Foundation
- » OPC UA CS in work

OPC UA for Machinery



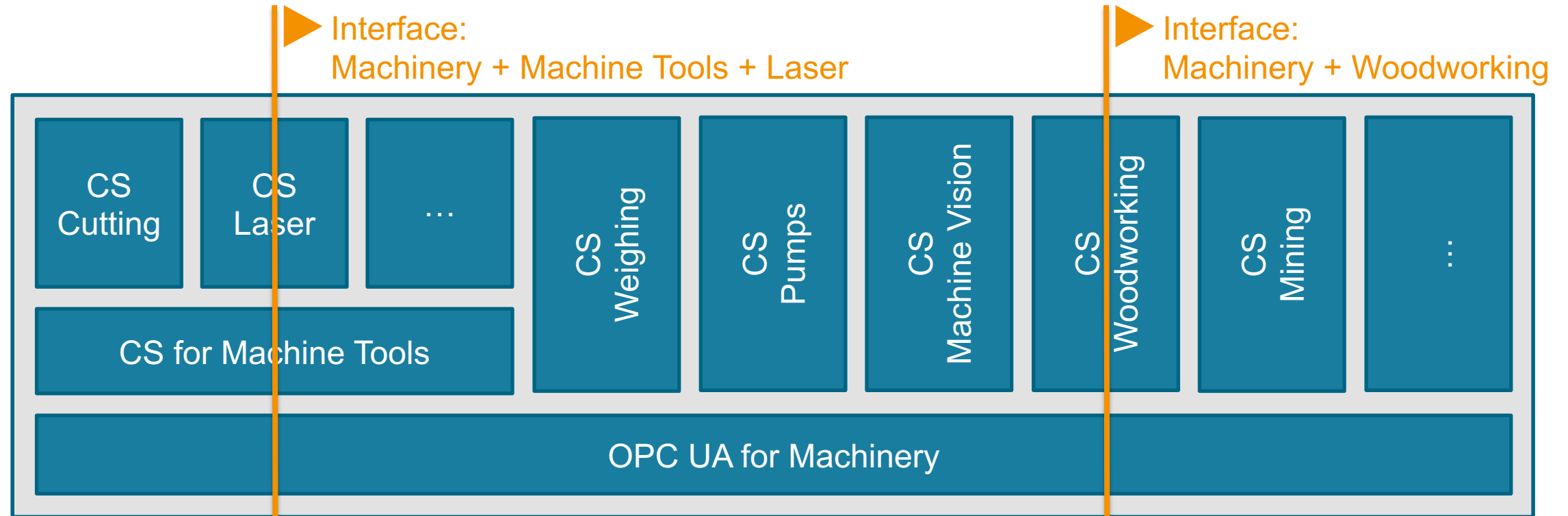
- **OPC UA Companion Specification for the whole Mechanical Engineering Industry**
 - Defines harmonized basic building blocks for broad use
 - Each building block stands for a specific use case



- **Can be referenced from other Companion Specifications or implemented as standalone model**

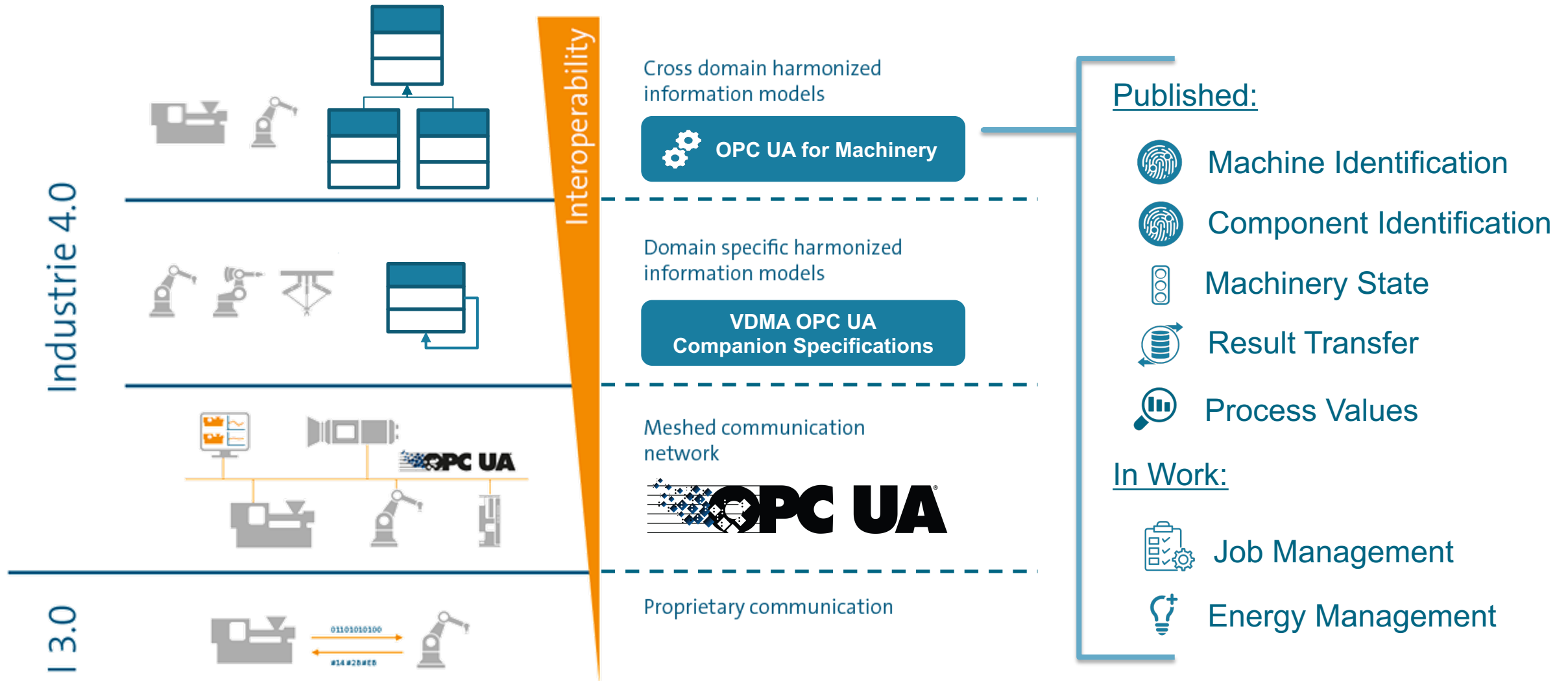
→ **OPC UA for Machinery forms the basis for interoperability**

OPC UA for Machinery Target Image



→ OPC UA for Machinery as Base CS for the whole field of mechanical engineering.

OPC UA serves as basis for the Global Production Language



OPC UA for Machinery

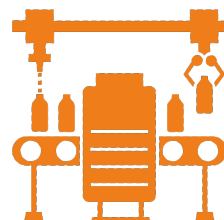
Machine Identification



Which machine is it?
Who built it?

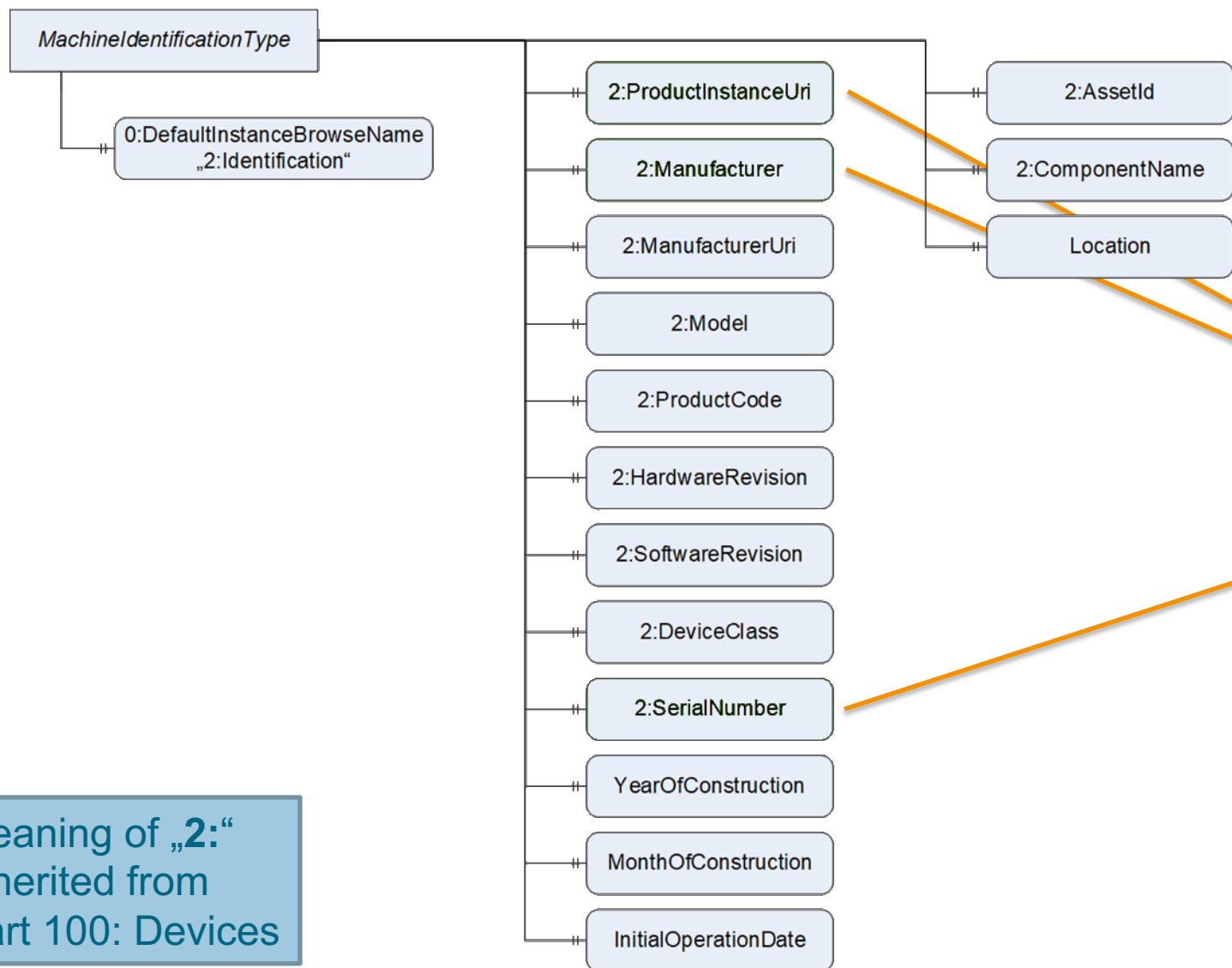


OPC UA for Machinery provides
this information in the same way!



* The use case ensures unique identification of the unit.

Machine Identification

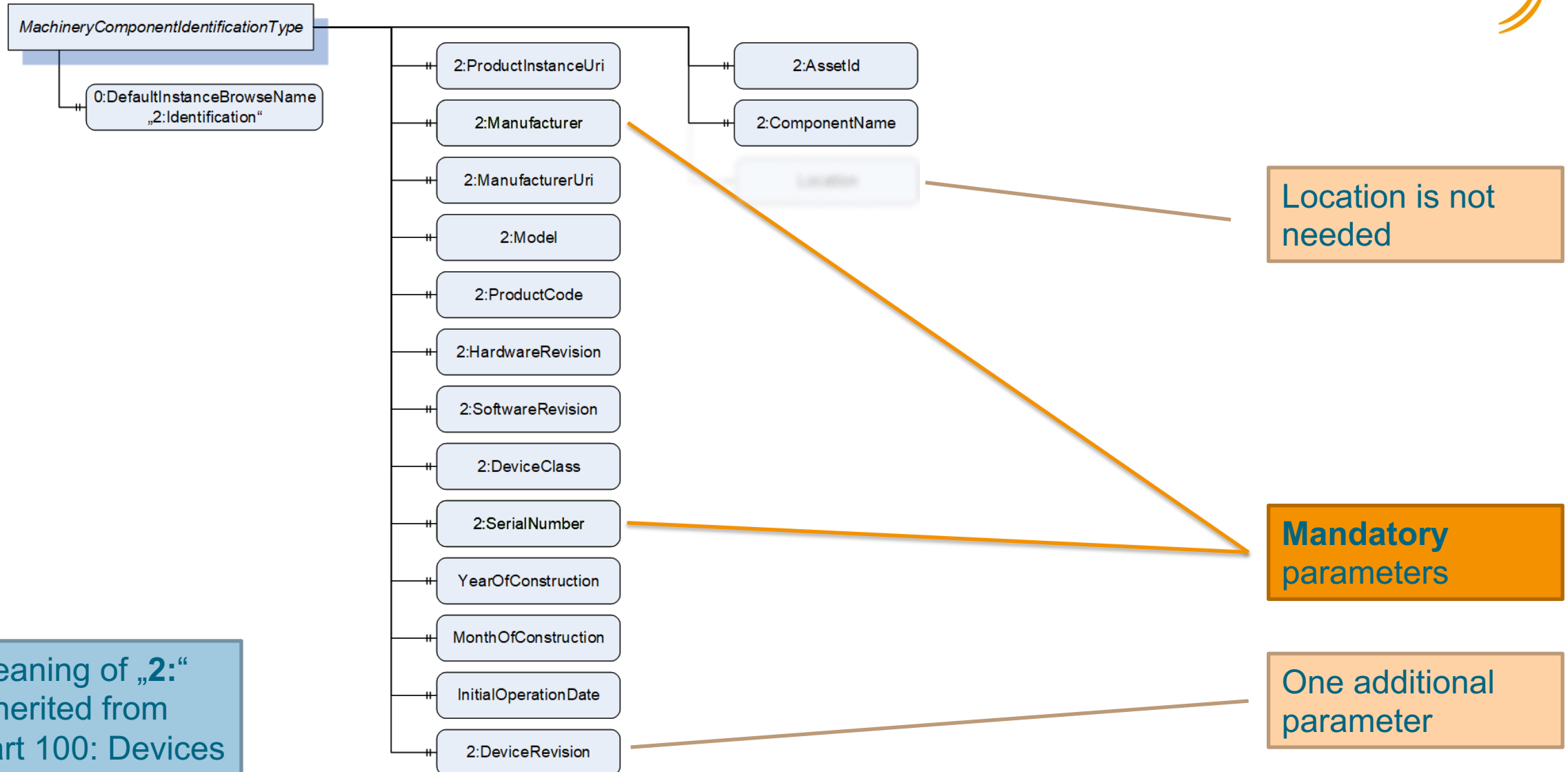


Meaning of „2:“
Inherited from
Part 100: Devices

**Mandatory to
achieve unique
identification**

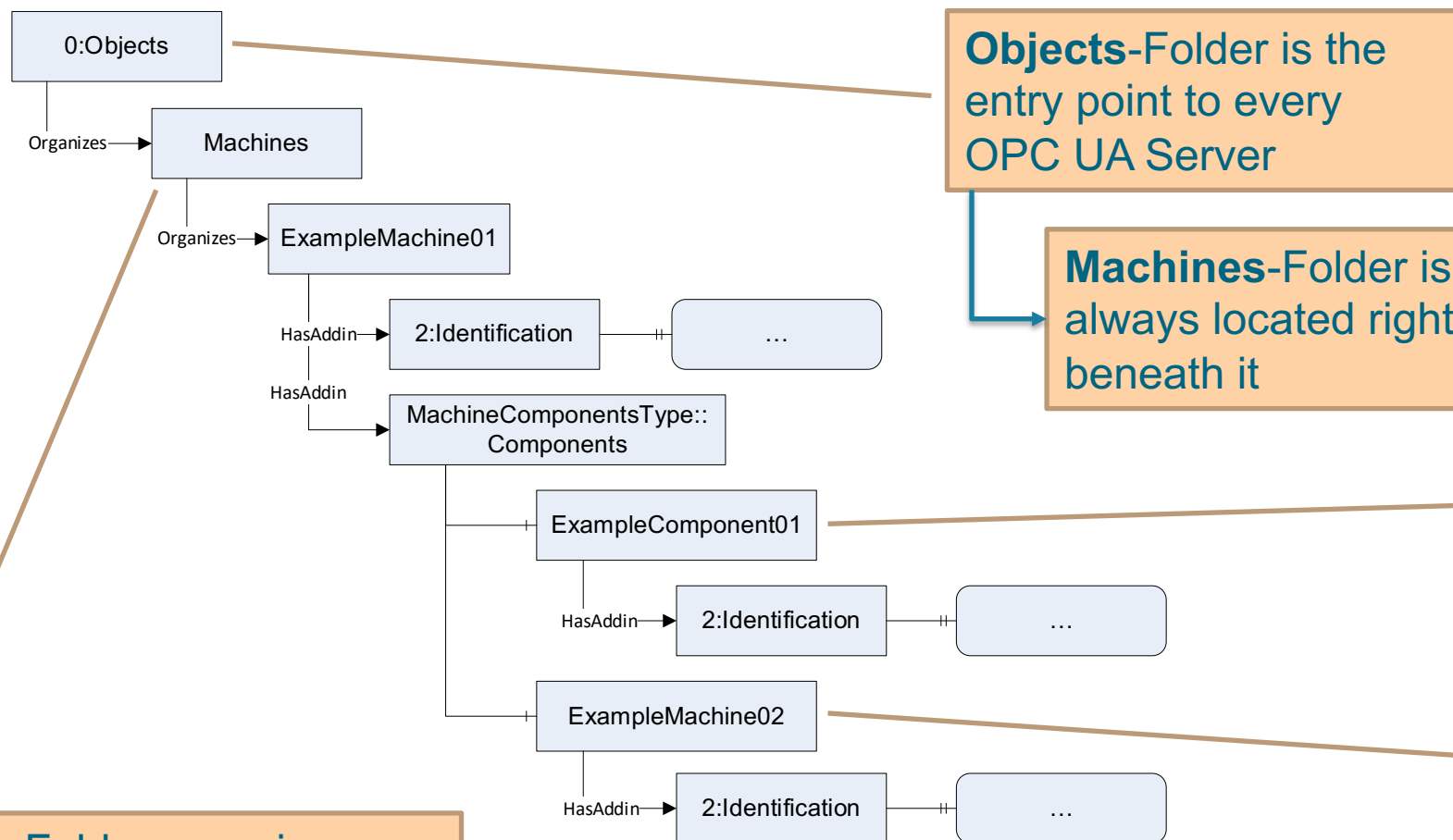
➔ using OPC UA common models (DI)
to gain higher interoperability

Component Identification



Meaning of „2:“
Inherited from
Part 100: Devices

Listing of Machinery Items



Objects-Folder is the entry point to every OPC UA Server

Machines-Folder is always located right beneath it

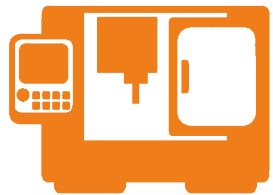
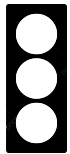
Lists all Components to a specific machine

Even Machines can be Components of machines

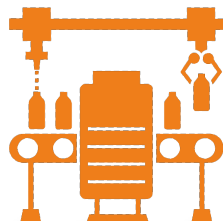
Machines-Folder organizes any Machine that provides the MachineIdentificationType

Machine State

Current Problem



Working



Running



Executing



Production



Dry Run

Machinery State

Machinery Item State Definition

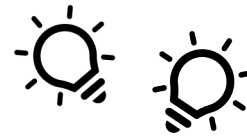
Applicability: OPC UA Server running

Not available	The unit is not available and does not perform any activity*. (e.g. Switched Off, in Energy Saving Mode)
Out of Service	The unit is not functional and does not perform any activity*. (e.g. Error, Blocked)
Not Executing	The unit is available & functional and does not perform any activity*. It waits for an action from outside to start or restart an activity*.
Executing	The unit is available & functional and is actively performing an activity* (pursues a purpose)

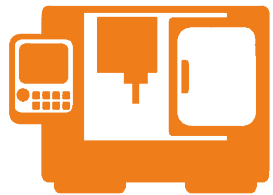
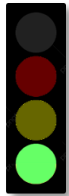
* activity = part of the production, preparation or maintenance process

Machinery State

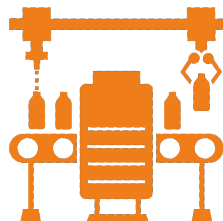
Machine View



Everything is fine!



Executing



Executing



Executing



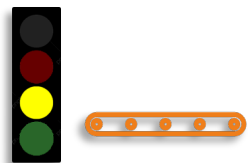
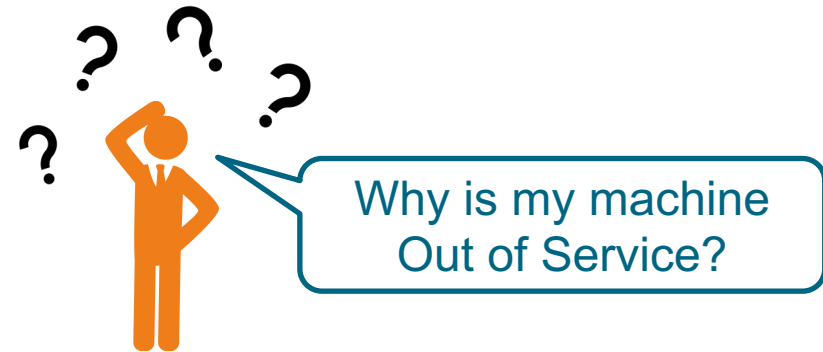
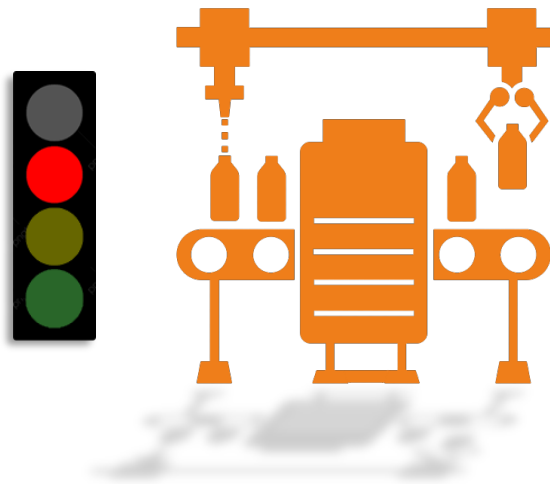
Executing



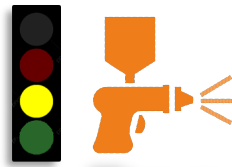
Executing

Machine Monitoring

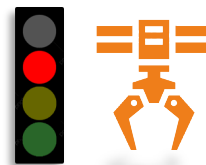
Component View



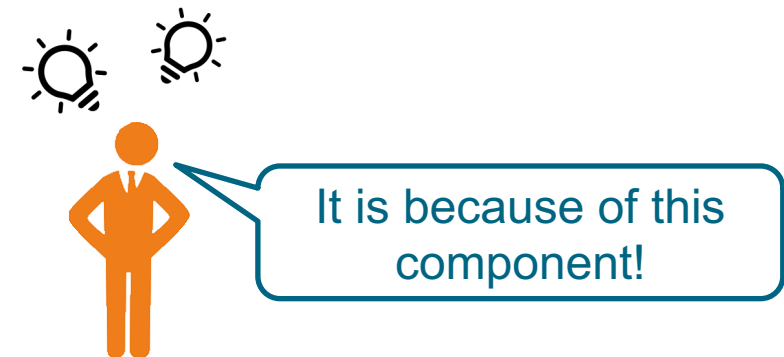
Conveyer



Injection



Gripper



*This example shows a beverage filling line that is Out of Service due to a jammed gripper.

KPI Calculations

Key Performance Indicators

Out of Service
+ Processing



2 hours

Not Executing
+ Processing



1 hour

Executing
+ Processing



5 hours

Machinery Item State
+ Machinery Operation Mode



Enables KPI Calculations*

ISO 22400

Actual Production Time = 5 hours

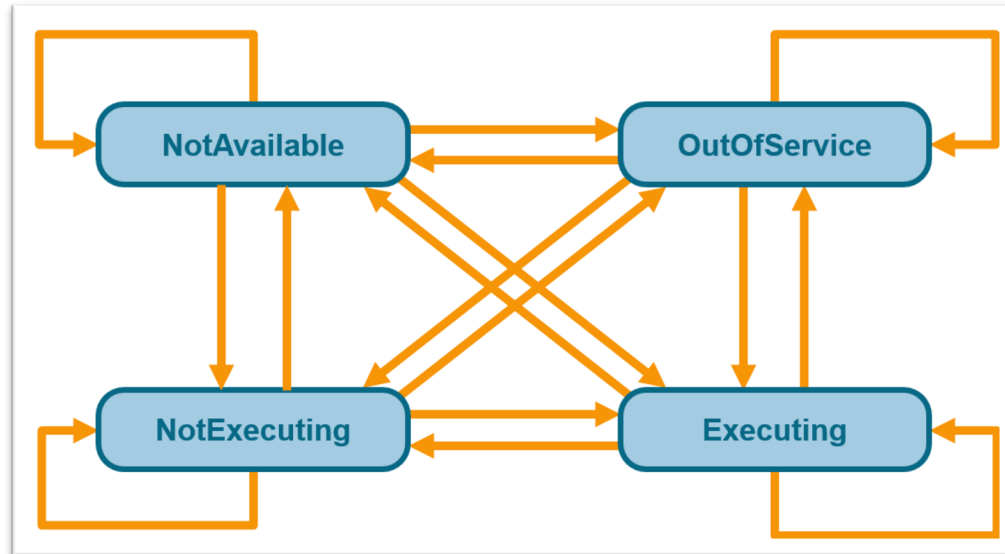
Planned Busy Time = 8 hours

$$Availability = \frac{APT}{PBT} = 62,5\%$$

Easy example for a KPI Calculation
(Other calculations need more information than provided here)

Machinery State

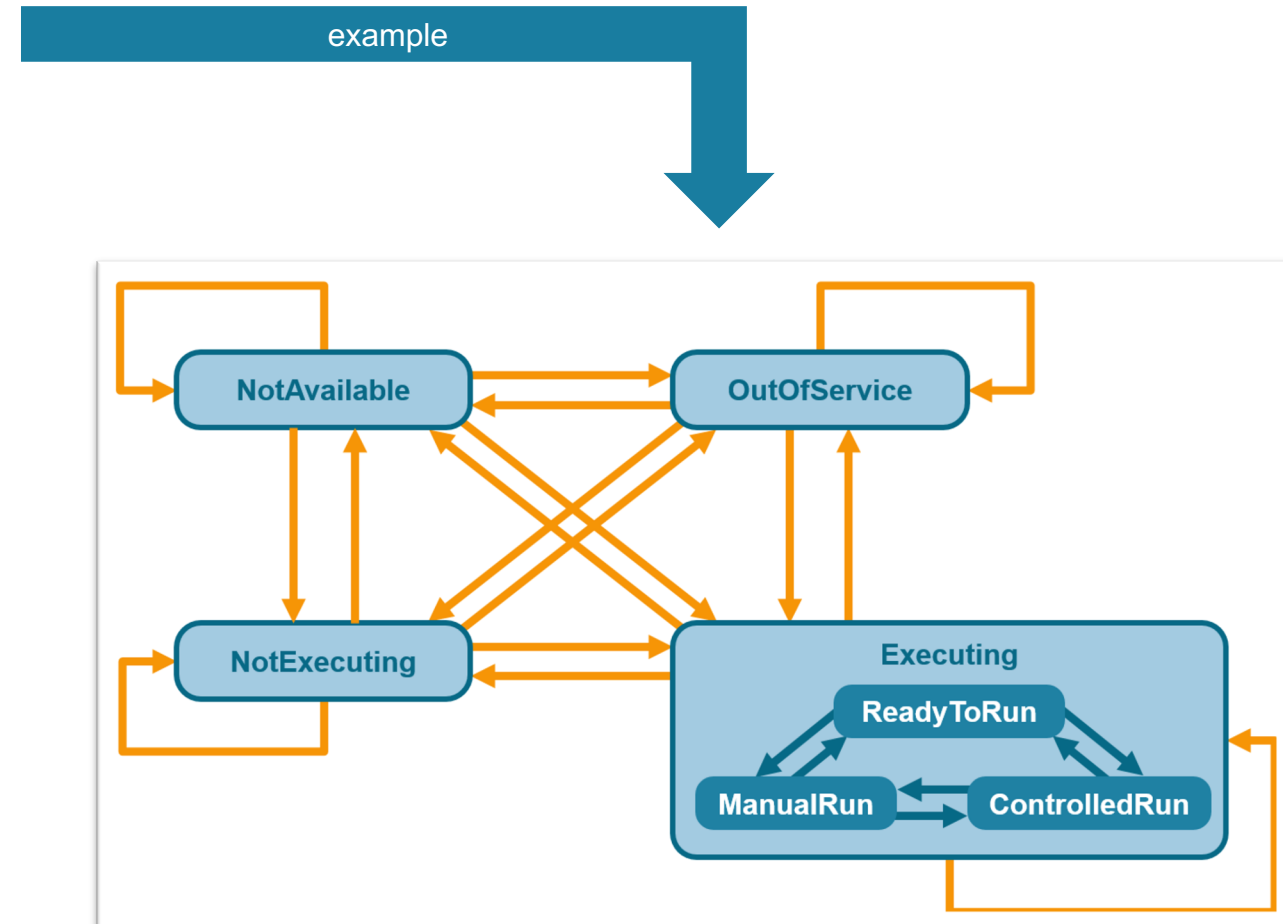
Specific Realization



MachineryItemState
in OPC 4001-1 – OPC UA for Machinery: Basic Building Blocks

➤ Modelling Approach

- State Machine
 - all transitions allowed
 - can be extended by substates



Extension of the MachineryItemState
in OPC 40084-1 - UA CS for PlasticsRubber - Extrusion

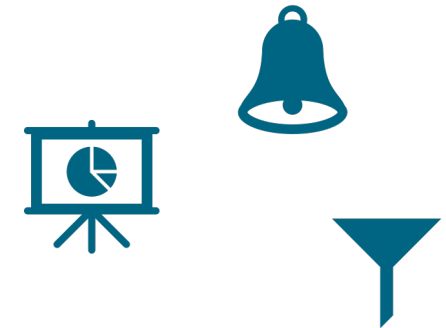
Result Transfer

Use Case

Receive **complex measurement results**, that might be created over a certain amount of time and potentially require some processing of raw measurement values.

Requirements:

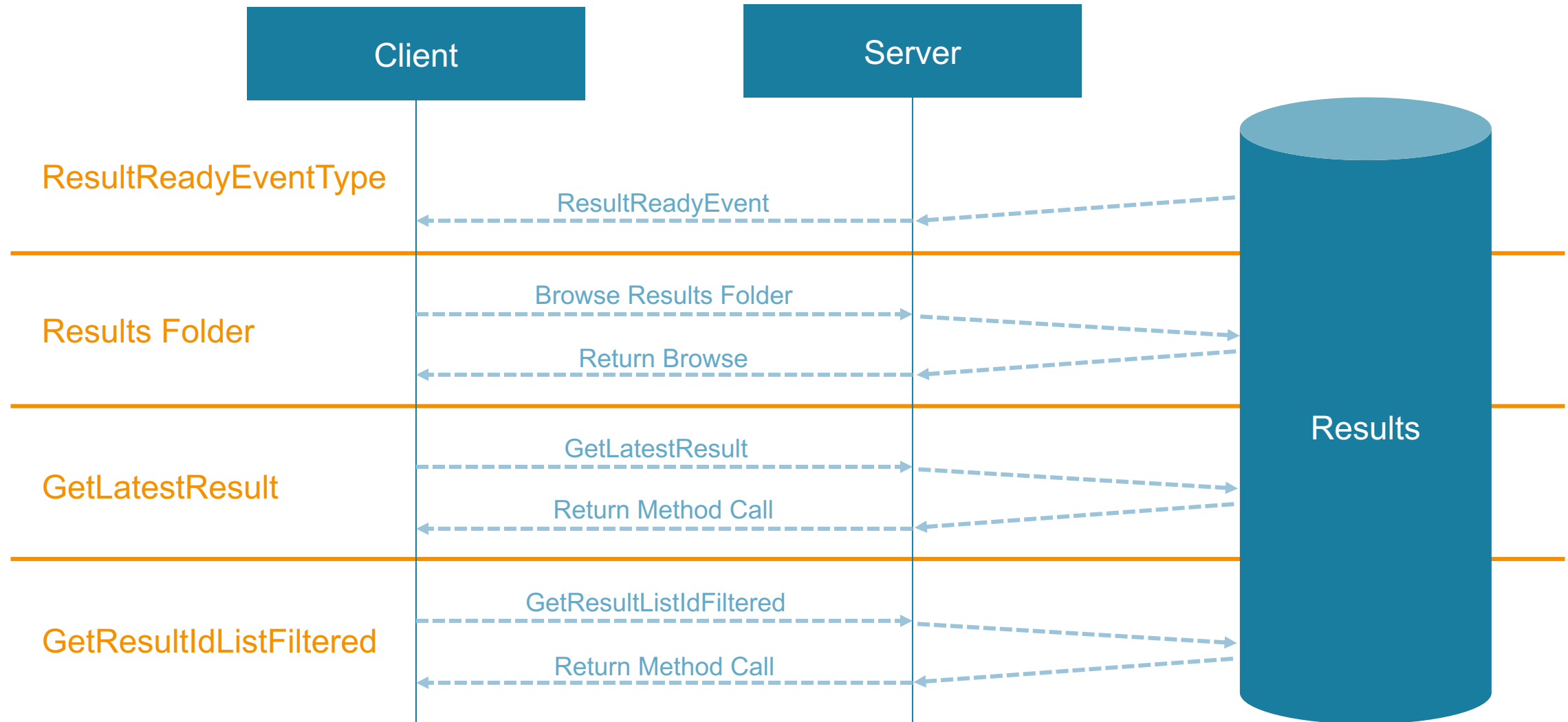
- Clients shall be **notified** if new results are available
- Clients shall be able to **access** individual results
- Clients shall be able to **filter** for specific results



*Note that the main purpose of the result transfer is to provide meta data together with the individual results.
For a simple transfer of measured values like a flow or temperature without such meta data there are simpler mechanisms in OPC UA like providing a OPC UA Variable with a specific measurement value.*

Result Transfer

Supports different mechanisms to access the results



Process Values

Domain specific information models



What are your internal states?

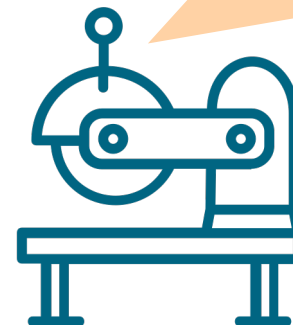
Temperature is at 53 degree F.



301°C is the temperature at the nozzle.



My blade is at 450 K.



Process Values

Harmonized Information Model

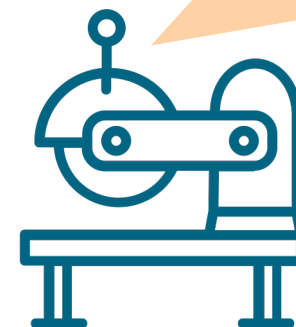


What are your internal states?

Temperature is at
53° F.

Temperature is at
53°C.

Temperature is at 450 K.

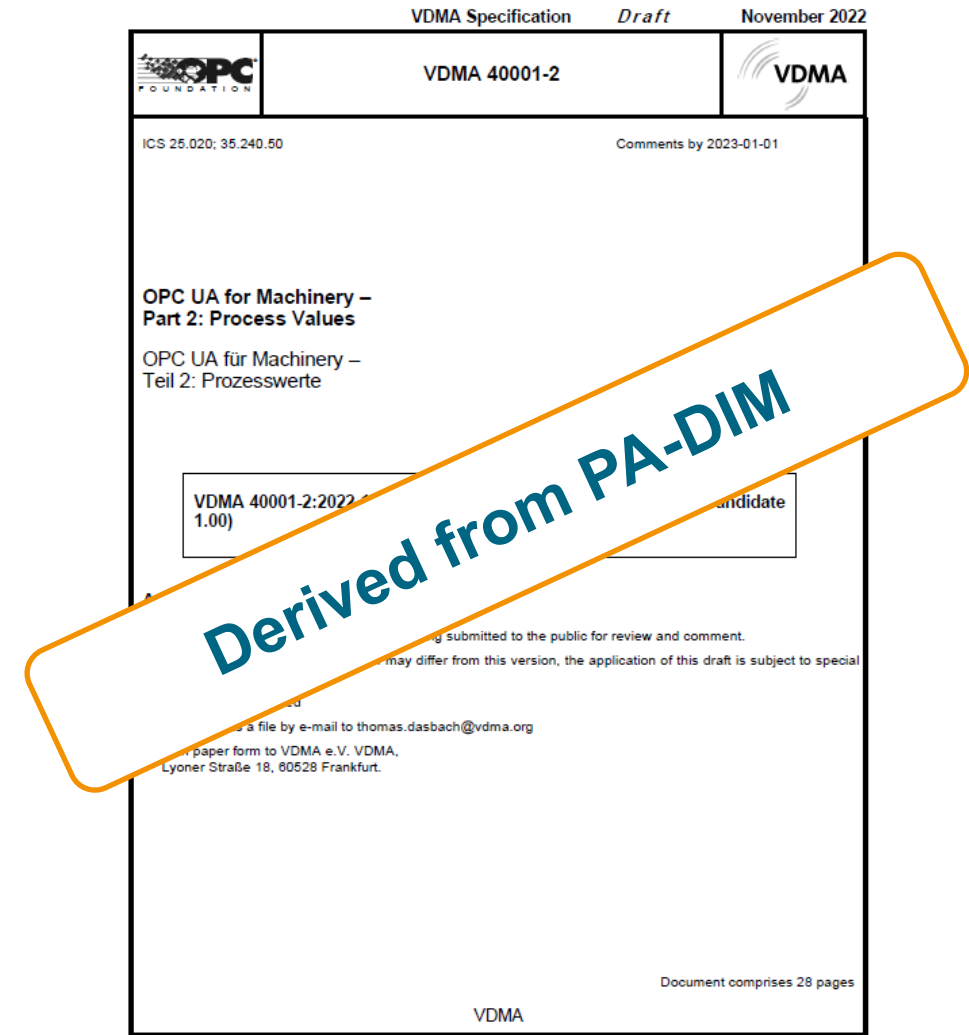


Process Values

OPC 40001-2



- **Meets the requirements:**
 - Actual Value
 - Setpoint Value
 - Engineering Unit
 - Instrument Range
 - Deviation Limits and General Limits
 - Status (in range/out of range/...)
 - Alarms
 - Zero Point Adjustment
 - Substitution Value
 - Device Identification & Health
 - ...





Summary

- “**OPC UA for Machinery**” forms the **basis** for harmonization in the machinery and plant engineering industry
- It is structured in **Building Blocks**. These stand for specific Use Cases. Many Building Blocks are already available, more are in work.
- It can be **referenced by other Companion Specifications** or used in a stand-alone interface.
- The standards are **free of charge**.

Thank you
Thank you
for your attention!



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