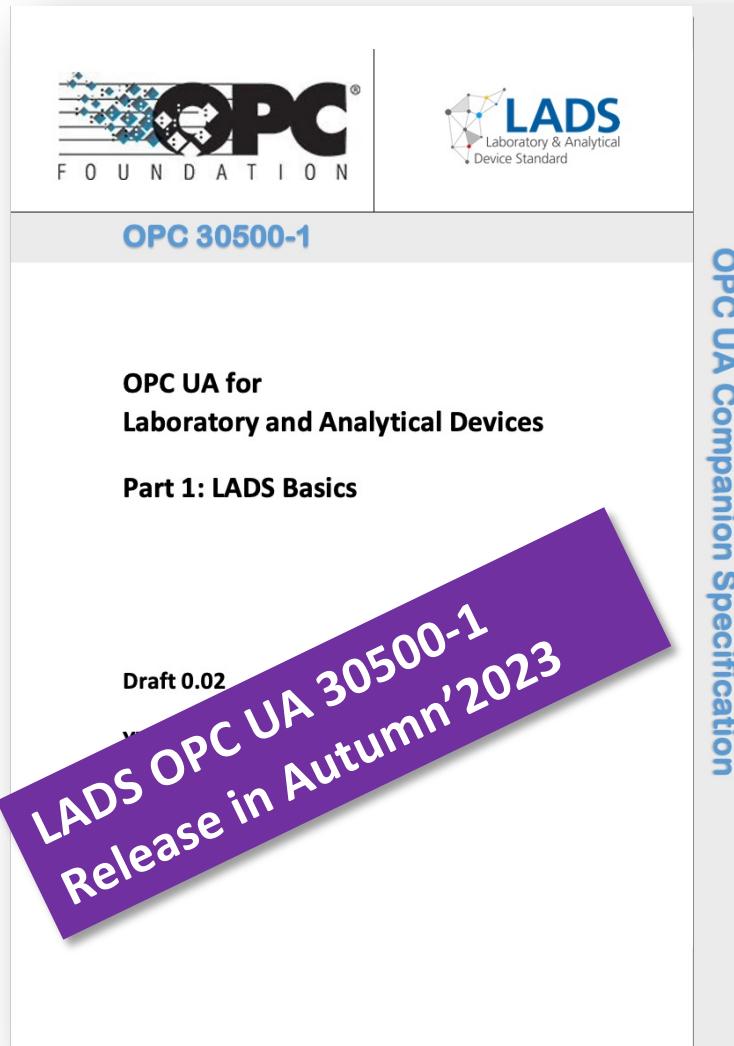




# LADS OPC UA

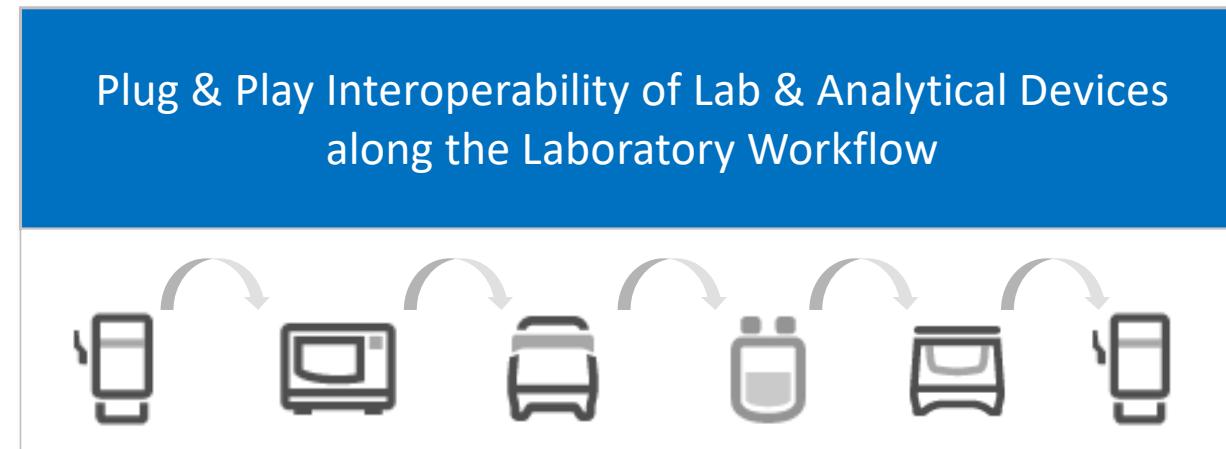
## The Laboratory and Analytical Device Standard

Dr. Matthias Arnold  
Future Labs Live 2023  
Basel, Switzerland





## LADS Target Image



# Plug & Play- Interoperability of Lab & Analytical Devices

**Lab & Analytical  
Applications**

SCADA

LIMS

ELN

...

Service  
Management

**“Common Language” for  
Lab & Analytical Devices**

LADS OPC UA



**Lab & Analytical Devices**



## LADS Use-Cases

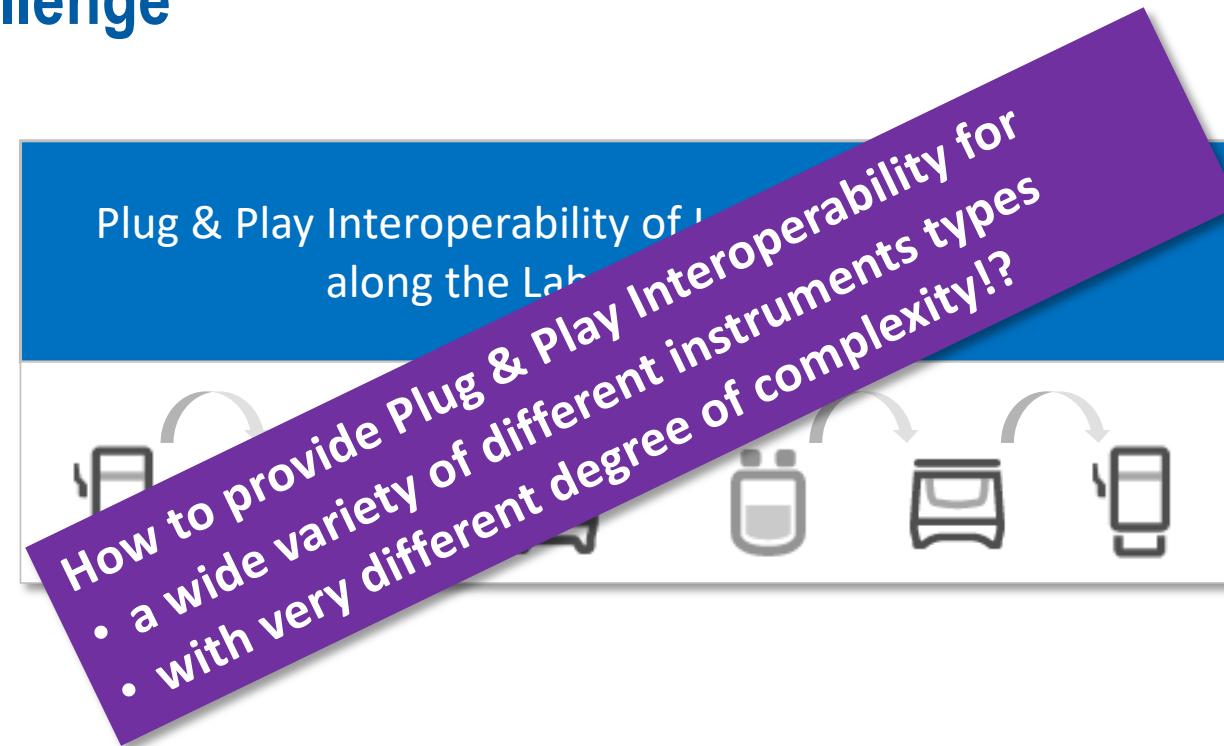
-  **Remote Monitoring, Alarms & Notifications**
-  **Remote Control**
-  **Program Management & Orchestration**
-  **Results Management**
-  **Condition Monitoring & Maintenance**
-  **Device & Fleet Management**

Basic Automation

Orchestration

Service & Asset Management

## LADS Challenge

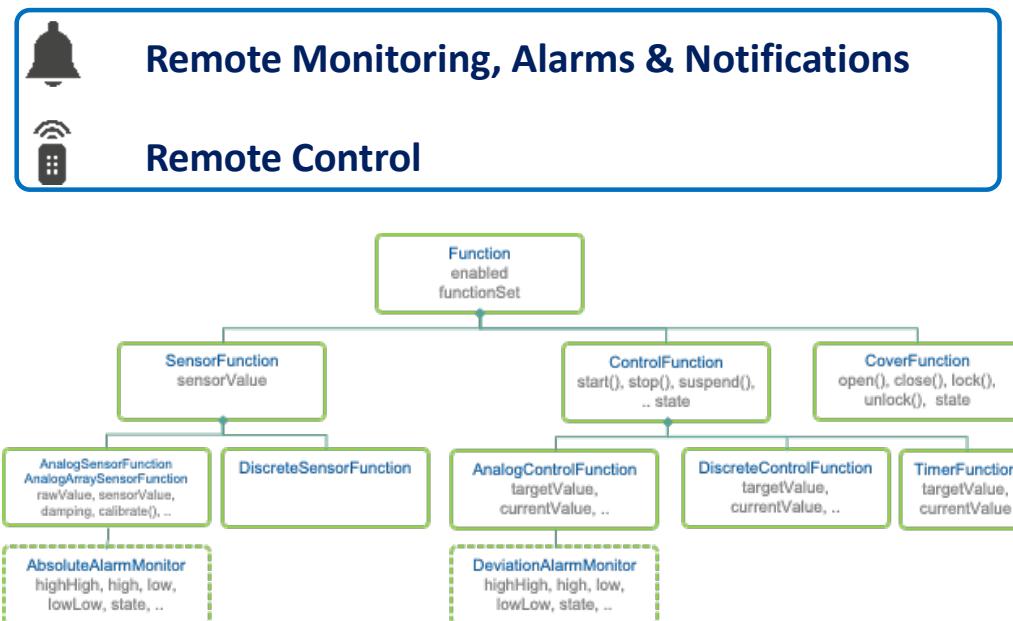


Plug & Play Interoperability of  
along the Lab Workflow

How to provide Plug & Play Interoperability for

- a wide variety of different instruments types
- with very different degree of complexity!?

# LADS OPC UA Plug & Play Interoperability ..



## Remote Clients can easily

- Explore and utilize all functions like sensors, controllers, timers, covers, .. of a device
- Access all required meta-data like type and role, names, descriptions, status, data-types, ranges, engineering units, ..
- Augmented by associated event logs (audit trail) and data histories, ..

without configuration!

.. utilizing standardized patterns and building rules ..

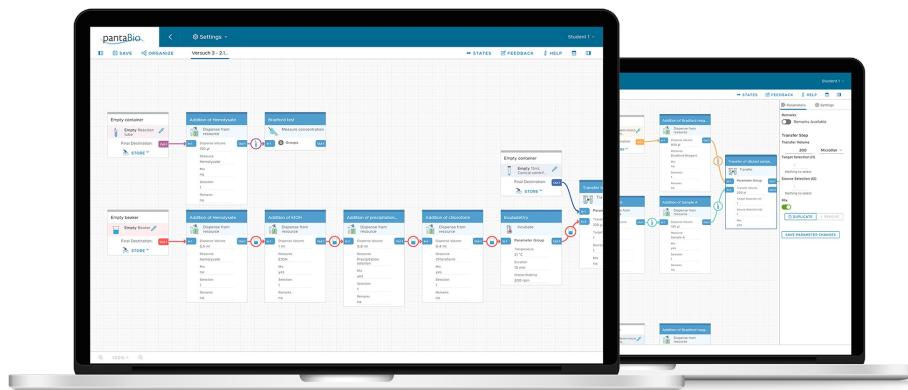
## LADS OPC UA Plug & Play Interoperability ..



**Program Management & Orchestration**



**Results Management**



**Remote Clients can easily**

- List, upload, download methods/program templates stored on a device
- Start runs based on a specific template, providing all required contextual information, like, job, task, samples, ..
- Monitor a run's status & progress
- Access results of a run including context information, end-points, files, ..

without configuration!

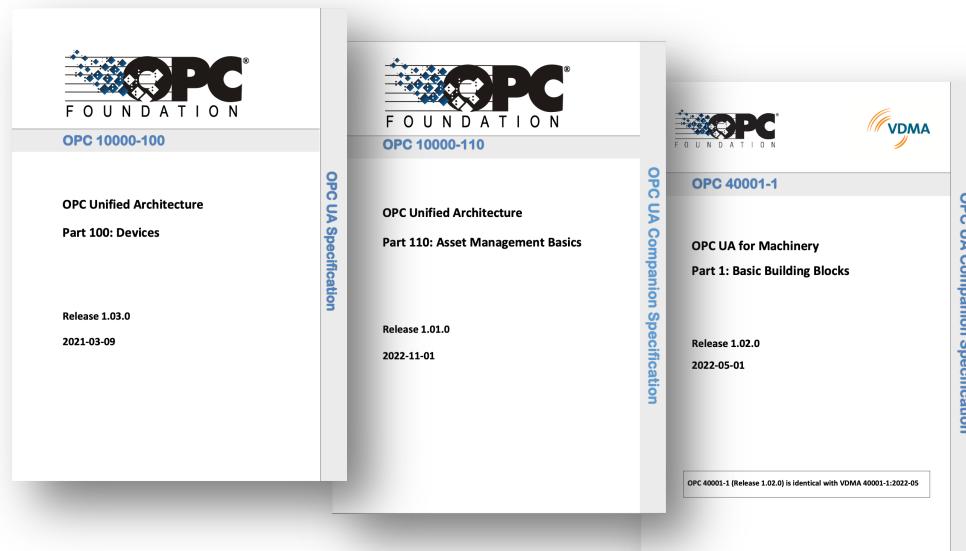
# LADS OPC UA Plug & Play Interoperability ..



**Condition Monitoring & Maintenance**



**Device & Fleet Management**



**Remote Clients can easily**

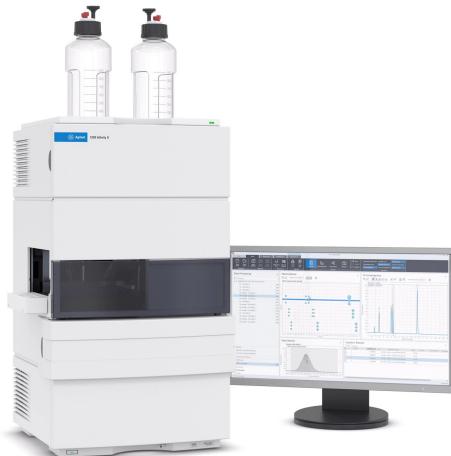
- Explore nameplates, condition monitoring variables, health status, etc. of a device and its components
  - Read the location of devices
  - Access status of recurrent tasks like service, maintenance, validation, calibration cleaning
  - Based on Industrial Interoperability standards
- without configuration!



# LADS Hackathons & Workshops → Agile Real-World Proving

## LADS OPC UA Information Modeling Examples





## HPLC System

Analytical Instruments

Agilent 1220 Infinity II LC G4294B



## Real time PCR

Analytical Instruments

Analytik-Jena qTOWER3 auto real-time PCR

## Centro LB 963 Microplate Luminometer

The Centro is a high-performance, easy to use microplate luminometer for both flash, and glow luminescence applications.

The optimized design provides excellent performance and flexibility:

- Superior sensitivity (<1.8 zmol firefly luciferase)
- Negligible crosstalk ( $10^4$ )
- Built-in shaker
- JET-injectors
- Temperature control (model-dependent)
- Ergonomic design
- Automation compatibility



The Centro is ideally suited for all luminescent reporter gene assays, immunoassays (LIA, ILMA), cell-based, and biochemical assays.

To meet your compliance requirements, a set of validation tools and optional software providing 21 CFR part 11 compliance are available.

## Luminometer

Analytical Instruments

Berthold Centro LB 963



## Absorbance Plate Reader

Analytical Instruments

byonoy Absorbance 96 plate reader



## HPLC Radioisotopes Detector

Analytical Instruments

Eckert & Ziegler FlowCountPRO



## TLC-Scanner

Analytical Instruments

Eckert & Ziegler AR-2000



## Liquid Handling System

Liquid Handling & Automation

Brandt - Liquid Handling Station



## Precision Liquid Handling

Liquid Handling & Automation

Certos / Hamilton Microlab® 700



## Worktable CO<sub>2</sub> Incubator

Automation & Cell Handling

SCILA CO<sub>2</sub> 4-Position cell incubator



## Wireless Sensor Systems

Environmental & Sample Centric Sensing

essentim

Amensio



## Thermo Mixer

General Lab Equipment

Generic



## Parallel Mixer

General Lab Equipment

2mag MIX4 MS

..



## Freezer

General Lab Equipment

Generic



## Incubated Shaker

General Lab Equipment

Generic



## Balance

General Lab Equipment

Generic



## Thermostat

Temperature Management

Julabo  
Lauda

..



## Centrifuges

General Lab Equipment

Generic



## Rotation Evaporator

General Lab Equipment

Heidolph – Hei-VAP Expert/Ultimate Control

..



## Dynamic Mechanical Analyzer

QC Equipment

Netzsch –DMA GABO EPLEXOR® HT



## Process Mass Spectrometer

PAT Equipment

In-Process GAM 2000 Multicomponent  
Online Gas Analyzer



## Single / Parallel Bioreactor Systems

Bioprocess Equipment

Generic, e.g.,  
Eppendorf  
Infors  
sartorius

..



## Electronic Lab Notebook

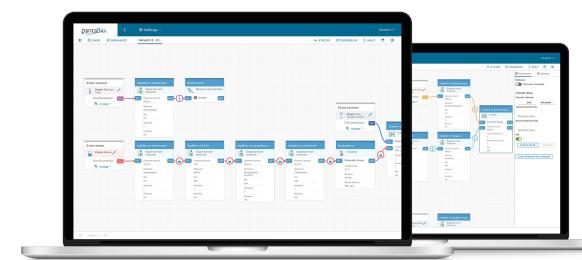
Software

LabForward - LabOperator

## Workflow Planning

Software

pantaBio - process design tool



## LIMS

Software

Integris iLIMS

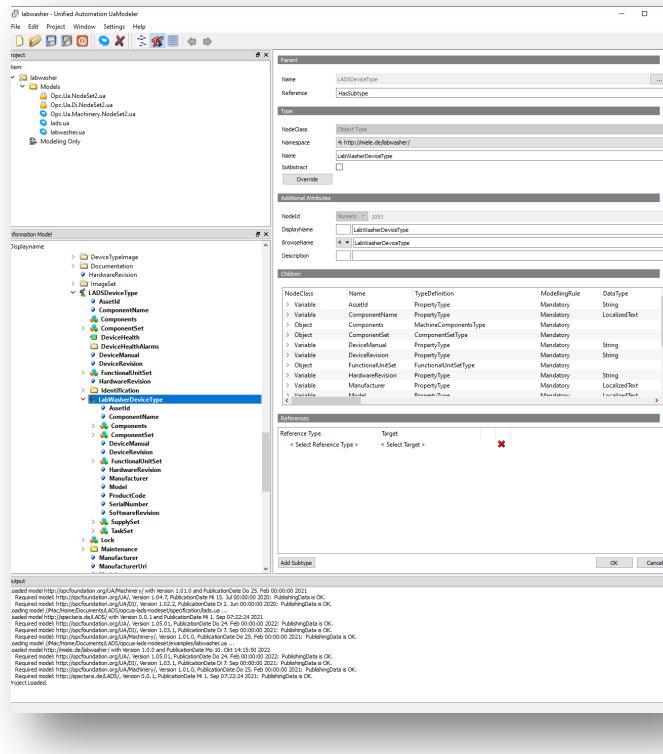




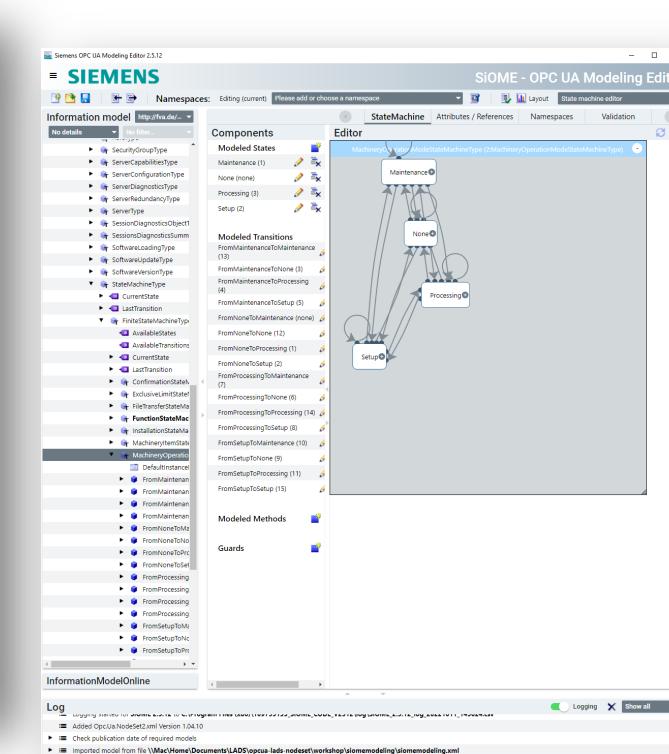
## LADS OPC UA – Proud member of the OPC UA eco-system!

Tools & Tech Stacks

## Tools – Modeling (excerpt)



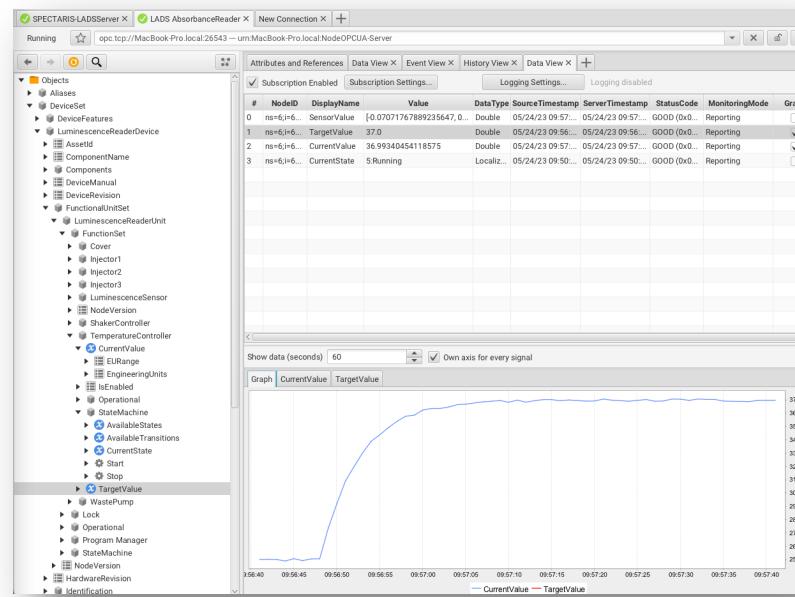
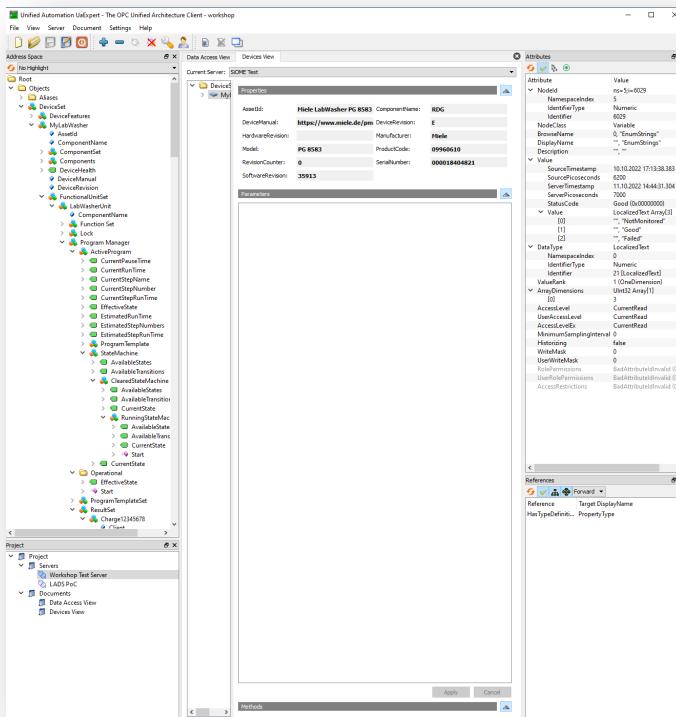
The screenshot shows the Labwatcher - Unified Automation UA Modeler interface. On the left, there's a navigation tree for 'ladsbase' with various nodes like 'DeviceImage', 'Imageable', 'LADSDeviceType', etc. The 'LADSDeviceType' node is selected. The main panel displays the configuration for 'LADSDeviceType', including fields for 'Name' (LADSDeviceType), 'Reference' (HasSubtype), 'NodeClass' (Object), 'Namespace' (http://lads-base/), 'Name' (LADSDeviceType), and 'Subselect'. Below this is a table for 'Additional Attributes' with columns 'Name', 'TypeDefinition', 'ModelingRule', and 'DataType'. A reference editor is open at the bottom.



The screenshot shows the Siemens OPC UA Modeling Editor 2.5.12. It features a central 'Components' pane listing various state machine types such as 'SecurityGroupType', 'AssetType', 'MachineComponentsType', etc. To the right, there's a 'StateMachine' editor window showing a state transition diagram with states like 'Maintenance', 'None', 'Processing', and 'Setup'. Transitions are labeled with actions like 'FromMaintenanceToMaintenance', 'FromMaintenanceToProcessing', etc. The bottom pane shows an 'InformationModelOnline' log.



## Tools – Browsing (excerpt)

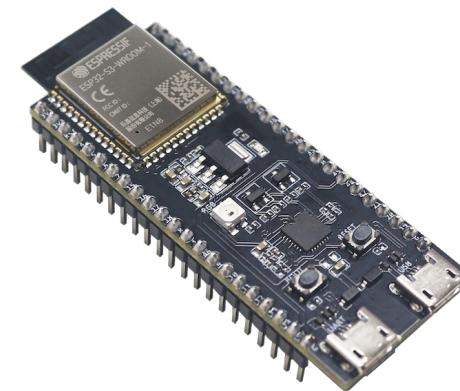


## Tech-Stacks (excerpt)

### Open Source

- C99 – open62451
- TypeScript NodeJS node-opcua
- .net – OPC Foundation
- Java – Eclipse Milo™
- Python - FreeOpcUa/opcua-asyncio
- ..

LADS OPC UA Stack runs on ESP32-S3-DevKitC



### Commercial

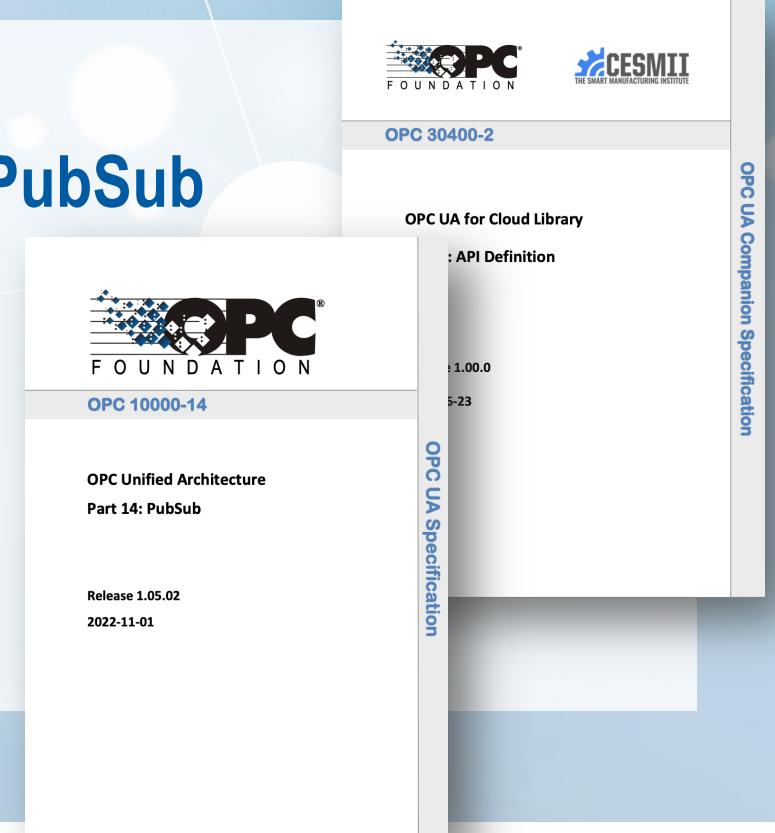
- C++, ANSI C, .net - Unified Automation
- Java, Delphi – prosSys
- ..



## LADS OPC UA in the Cloud - OPC UA PubSub

Unleashing the power of the OPC UA eco-system!

- PubSub
- Cloud Library





# OPC UA for Cloud



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Connect via an Edge Gateway e.g., UA Cloud Publisher

Welcome to the UA Cloud Publisher!

UA Cloud Publisher is a cross-platform OPC UA cloud publisher reference implementation leveraging OPC UA Pub/Sub over MQTT, running in a Docker container or on Kubernetes and it comes with an easy-to-use web user interface.

**Features**

- Cross-platform - runs on Windows and Linux
- Runs inside a Docker container
- UI for connecting to, browsing of, reading nodes from and publishing nodes from an OPC UA server
- Uses OPC UA Publish/JSON encoding
- Uses plain MQTT broker as publishing endpoint
- Optionally uses plain Kafka broker as publishing endpoint
- OPC UA Data Change Notifications
- OPC UA Alarms, Conditions & other events publishing
- OPC UA Event filtering
- OPC UA Complex Types publishing
- OPC UA metadata publishing
- OPC UA Forwarder publishing

<https://github.com/barnstee/UA-CloudPublisher>

Directly integrate OPC UA PubSub into your device

OPCFoundation / UA-IoT-StarterKit Public

Code Issues Pull requests Codespaces Marketplace Explore

Code Issues Pull requests Actions Security Insights

master · 1 branch · 0 tags · Go to file · Add file · Code ·

opcfoundation-org Update README.md · 1445bbb · On Aug 3, 2022 · 36 commits

- MqttAgent · Added command line args to set MQTT broker username/password. · 2 years ago
- MqttConfigCreator · Add metadata support. · 2 years ago
- Opclua @ f2d9508 · Update reference to latest .NET-Standard master. · 2 years ago
- docs · Refactor Subscriber configuration file to use a more typical pattern. · 2 years ago
- mqtt-spy · Add documentation. · 2 years ago
- .gitignore · Update readmes · 2 years ago
- gitmodules · add submodule · 2 years ago
- LICENSE.txt · Merge commits. · 2 years ago
- MqttAgent.sln · Add subscriber support. · 2 years ago
- README.md · Update README.md · 10 months ago
- \_config.yml · Set theme jekyll-theme-slate · 2 years ago

README.md

OPC UA Iot StarterKit

This repository is based on the 1.05.1 version of the specification.



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# LADS OPC UA @ OPC Foundation UA Cloud Show-Case

## Presented at Hannover Fair 2023

UA Cloud Dashboard

Microsoft OPC UA

UA Cloud Initiative Collaboration Partners

BECKHOFF Display KUKA Display Matrikon Display

METTLER TOLEDO Display PHENIX CONTACT Display PILZ Display

TRUMPF Display PROSYS Display SIEMENS Display

VDW Display WAGO Display

Unified Automation Display

**2mag magnetic motion** Display Agilent Trusted Answers Display

byonoy Display FHI Technopark BRAUNSTEIN Display GAMBICA Display

infoteam Display INTEGRIS Display Julabo Display

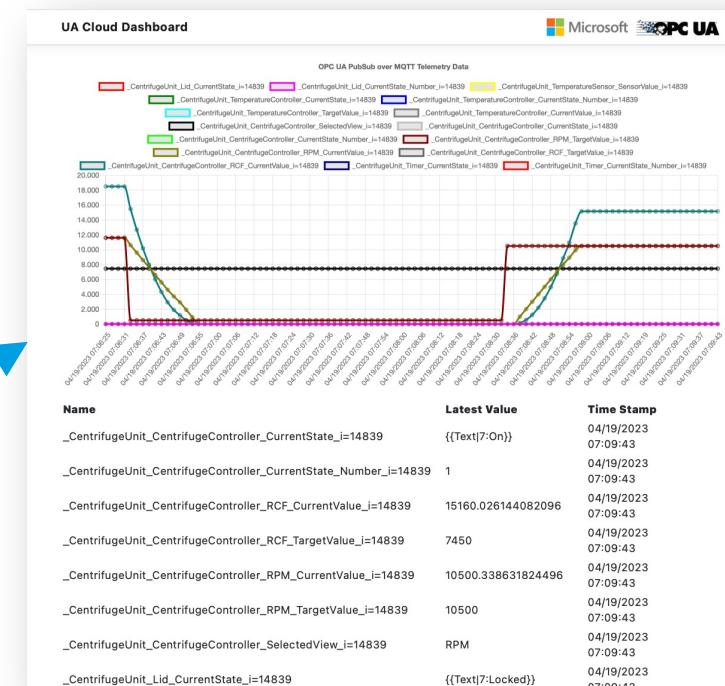
alresa Alresa centrifugation Display SPECTARIS Display avensio Display

BRAND Display essentim Display +LAB FORWARD Display

INFORS HT Display LAB GLOBAL LAB SOLUTIONS FROM SWITZERLAND Display

JAIMA Display BERTHOLD Display

LADS ready



# LADS OPC UA – Robots & Cobots welcome!

Unleashing the power of the OPC UA eco-system!

- Robotics
- Relative Spatial Locations



**OPC**  
FOUNDATION

**OPC 10000-210**

OPC Unified Architecture

Part 210: Relative Spatial Location

Release 1.00.1

2023-01-12

OPC 40010-1

OPC UA for Robotics

Part 1: Vertical Integration

Release 1.00

2019-07

OPC 10000-210: RSL

35

Release 1.00.1

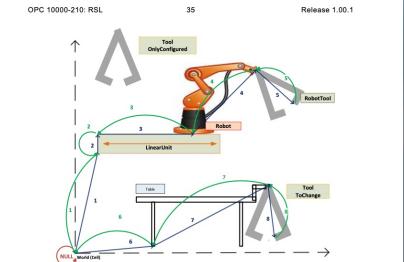


Figure 18 – Objects and their relative positions in an industrial application

Following figure (Figure 19) shows different representations how, for example, the SpatialObject of the LinearUnit can be described

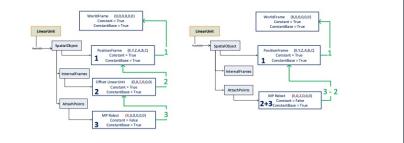
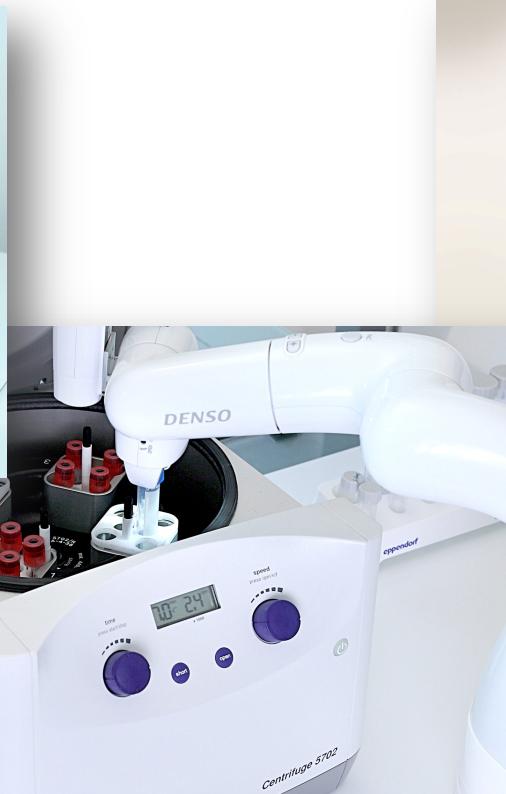


Figure 19 – Possible representations of the linear unit from the previous example



## Robots & Cobots based Lab Automation



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## Introducing the virtual cobot-enabled LADS OPC UA laboratory

LMSL Demonstrator - Cobots welcome!

