UNIVERSAL AUTOMATION.ORG

# UAO & IEC 61499

## Advancing open Automation

**Sarat Kumar Reddy Molakaseema**

*Chef Architect Officer*

UniversalAutomation.org

Opening Message:

# Power with Purpose

**WITH GREAT POWER COMES GREAT RESPONSIBILITY.**

**Use** the power of AI wisely—

**understand** its opportunities and challenges in depth,

and **act** with responsibility and foresight.

UNIVERSAL
AUTOMATION.ORG

# **ASSET-BASED** and **ASSET-CENTRIC** Industrial Automation

Introduction to Tterminology

# What is an ASSET?

A **physically or logically identifiable entity** that contributes to the operation, monitoring, or control of an industrial system


## Physical Assets:

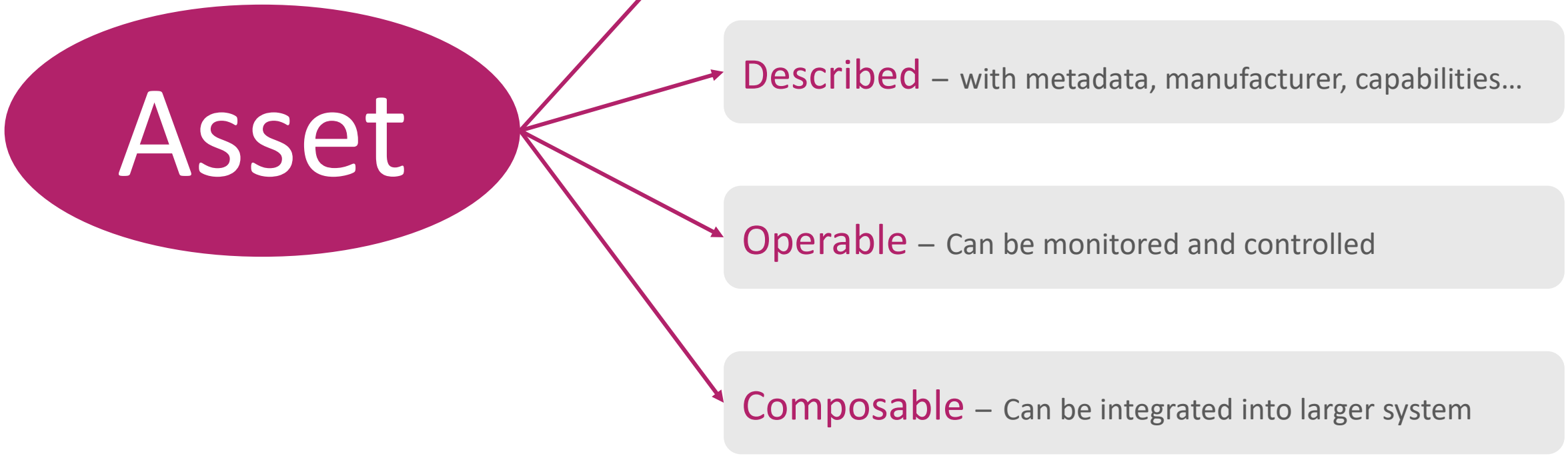
- **Machines** (e.g., CNC machines, robots)
- **Devices** (e.g., sensors, actuators, PLCs)
- **Infrastructure** (e.g., conveyors, tanks, valves)

## Logical (Virtual) Assets:

- **Software modules** (e.g., control logic, analytics)
- **Digital twins**
- **Data models or services** (e.g., OPC UA nodes, REST APIs)

Asset

# Characterization



# What is an **Asset Facet?**

An Asset Facet is a **logical partition** of an asset that **refers to a specific perspective** or aspect of an asset, that is of an interest to an actor interacting with the asset.

An Asset Facet is a **specific view of an asset** that **highlights information or functionality** relevant to a particular actor interacting with it.

| Actor | Interacts With Facet(s) | Purpose |
|---|---|---|
| **Operator** | Control and Monitoring | Start/stop machines, view status, respond to alarms |
| **Maintenance Technician** | Diagnostics, Lifecycle, Configuration | Troubleshoot issues, perform maintenance |
| **System Integrator** | Communication, Configuration, Control | Set up network, configure parameters, deploy logic |
| **Production Manager** | Monitoring, Performance, Lifecycle | Monitor KPIs, plan maintenance, optimize throughput |
| **Security Administrator** | Security | Manage access rights, audit logs |
| **Simulation** | Digital Twin, Monitoring, Control | Simulate behavior, validate control logic |
| **MES/ERP Systems** | Identification, Lifecycle, Performance | Track asset usage, integrate with business processes |

# Asset-BASED vs Asset-CENTRIC control

**Asset-BASED** control is the **strategic development of control applications** that ensure reliable plant or process operations by actively monitoring and managing assets. Its goal is to optimize asset performance, reliability, and lifespan - minimizing downtime, reducing maintenance costs, and extending operational life.

**Examples:**

- Condition-based control of heat exchangers for energy efficiency.
- Lifecycle-aware control of manufacturing robots to extend operational life.
- Proactive control of pumps to avoid failures.

**Asset-CENTRIC control** is a **strategic approach where control decisions are centered around the asset** itself emphasizing operational ownership, lifecycle management, and value optimization by aligning control strategies with the asset's performance, condition, and business objectives.

**Example:**

Scheduling heat exchanger operations and prioritizing maintenance based on business impact and return on investment (ROI), while applying condition-based control to optimize asset performance without compromising production goals.

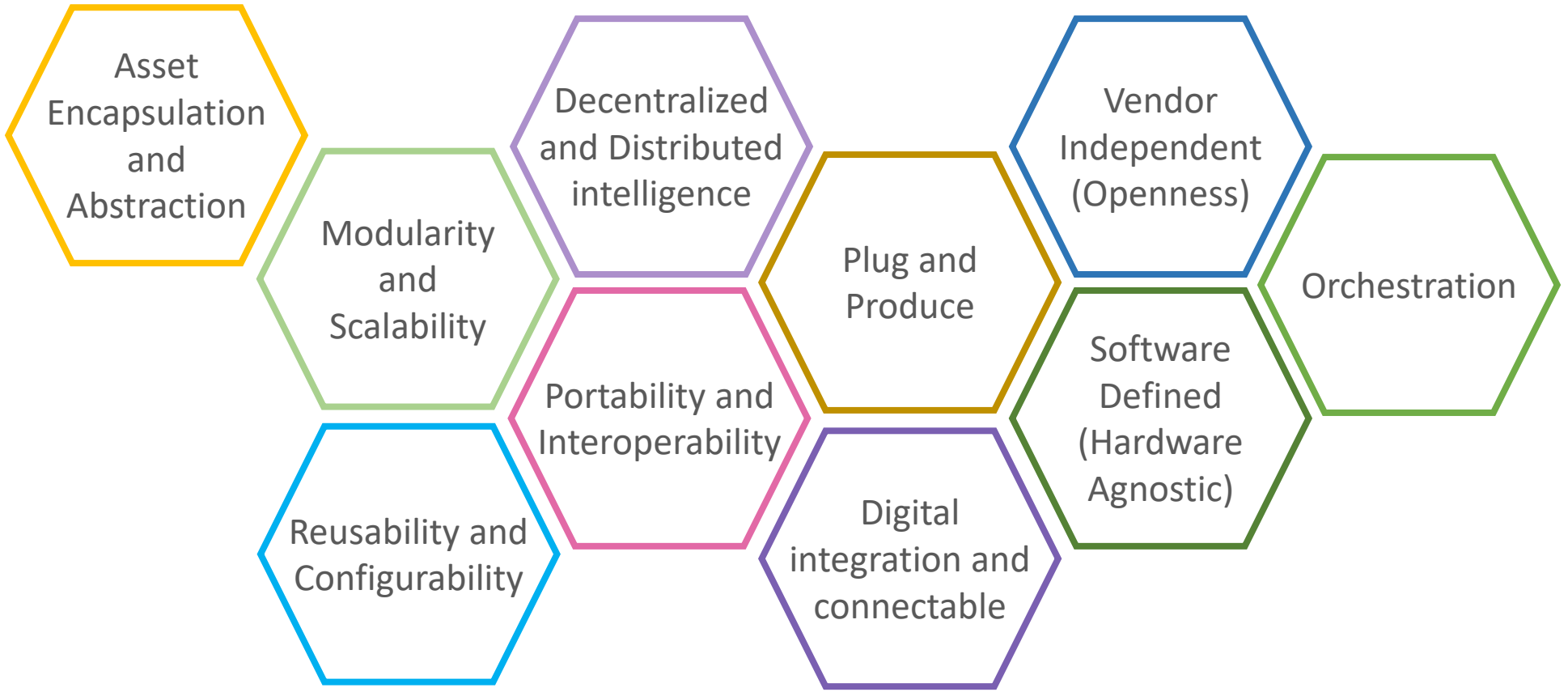
# Asset-based vs Asset-centric control

Continued…

| Feature | Asset-Based Control Engineering | Asset-Centric Control |
|---|---|---|
| **Focus** | Control logic tied to asset condition | Control logic orchestration centered on asset value optimization and business objective. |
| **Scope** | Engineering and automation systems | Strategic orchetsration of control |
| **Data to Use** | Real-time sensor data for control | Lifecycle and performance data for planning and scheduling |
| **Responsibility** | Engineers and control system designers | Production and operations planning and scheduling business unit |
| **Goal** | Optimize control performance and asset reliability | Maximize asset value and operational efficiency ensuring business objectives and production goals are met |

# Strategic control application

## Design & Development principles



# Critical programming constructs

Object-based and Object-oriented programming

Service Oriented Architecture and Development

Event driven modelling and programming

State machines and state-based control & opeartion

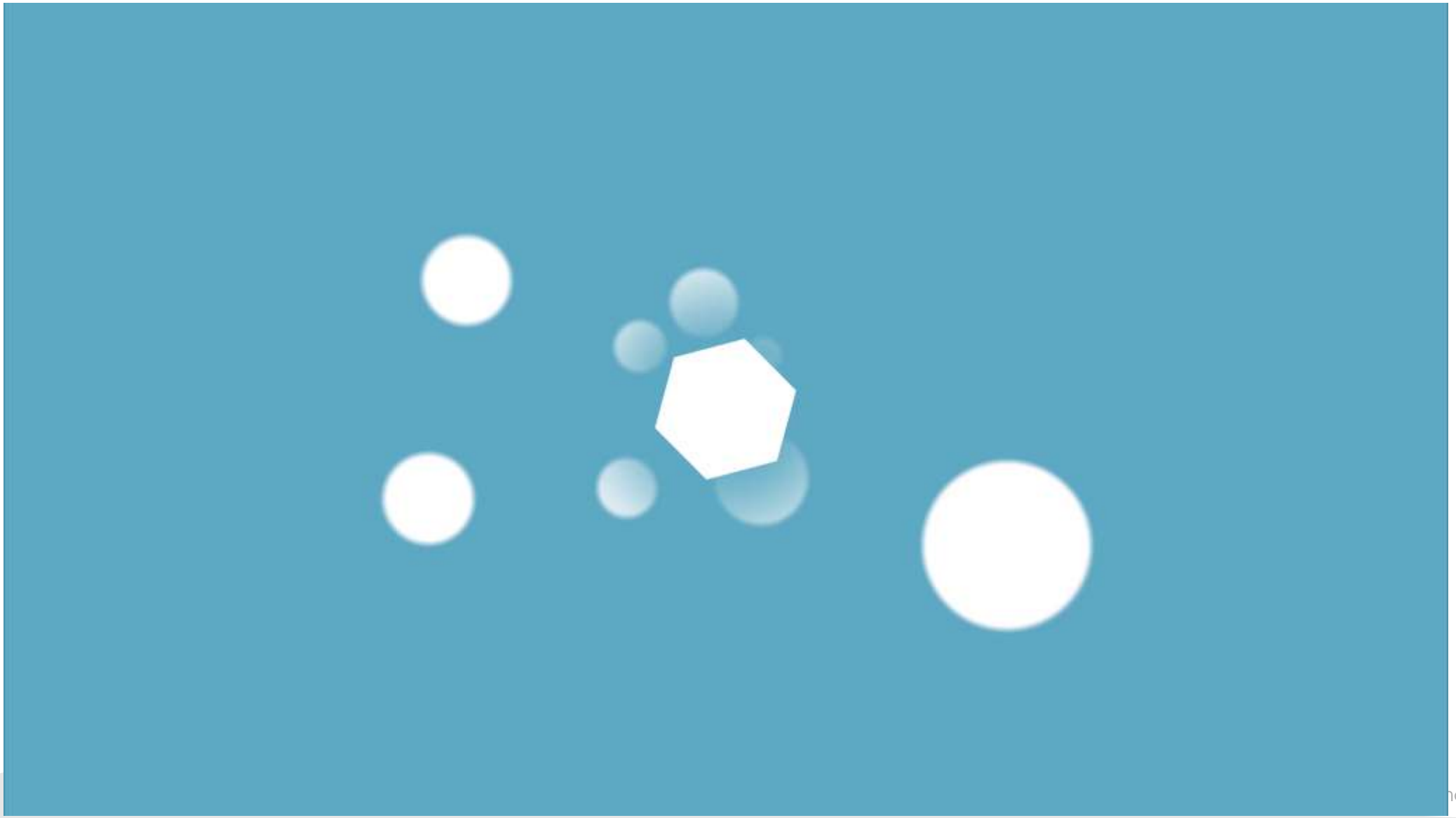
Asynchronous communications

UNIVERSAL
AUTOMATION.ORG

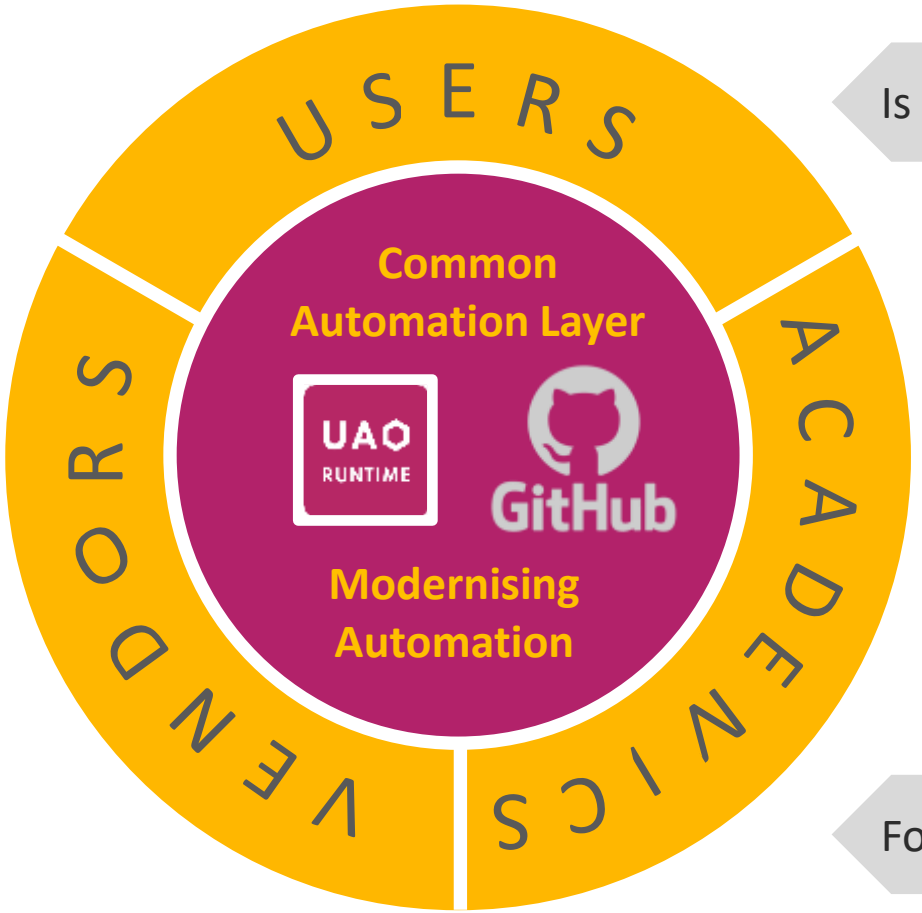
# INTRODUCTION

Universal Automation Organization

# Introduction



# What is
Universal Automation?




**Ecosystem**

- Is a non-profit organization
- Is an Eco-System of Automation Users, Vendors & Academics
- A Common Automation kernel based on IEC 61499
- Shared source model → best portability and interoperability
- Foster innovation and collaboration in automation industry

UNIVERSAL
AUTOMATION.ORG

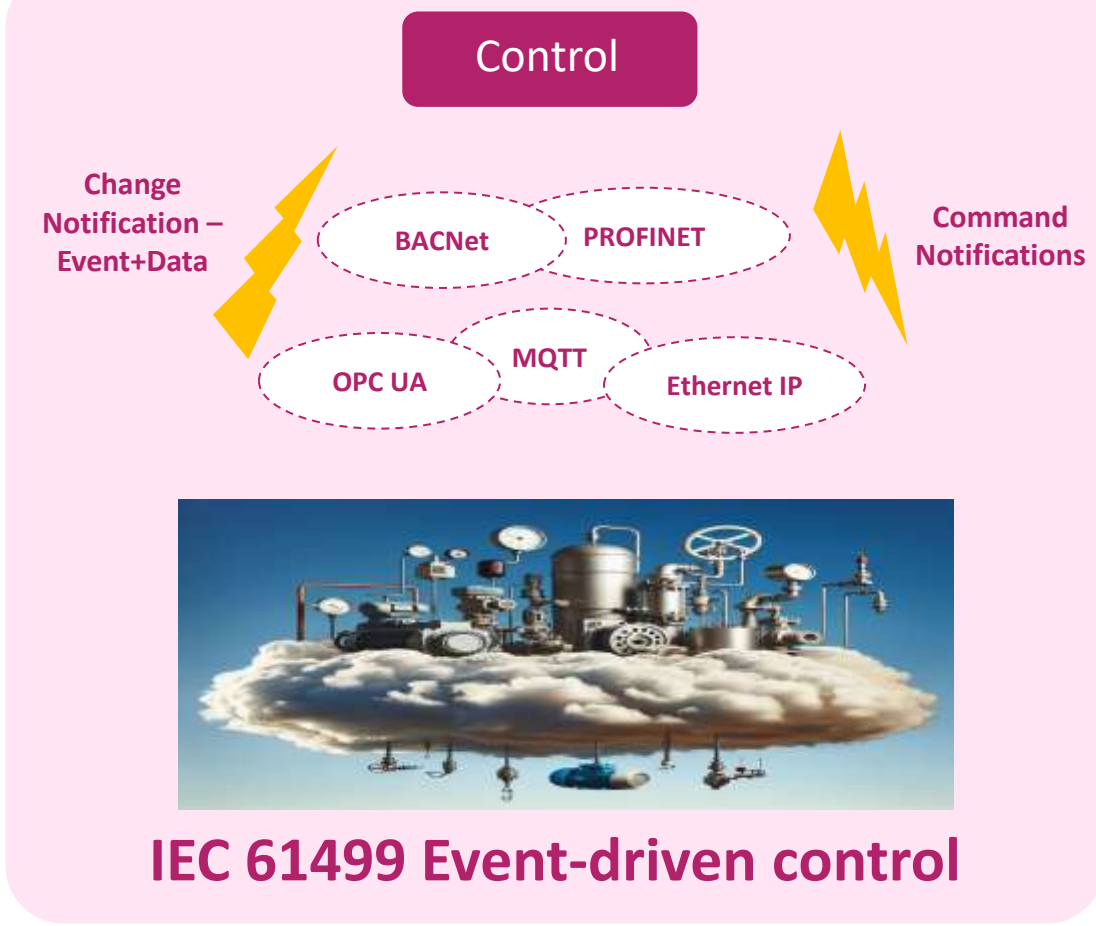
# HOW

Universal Automation Organization & IEC 61499

# IEC 61499

## The technology enabler of UAO

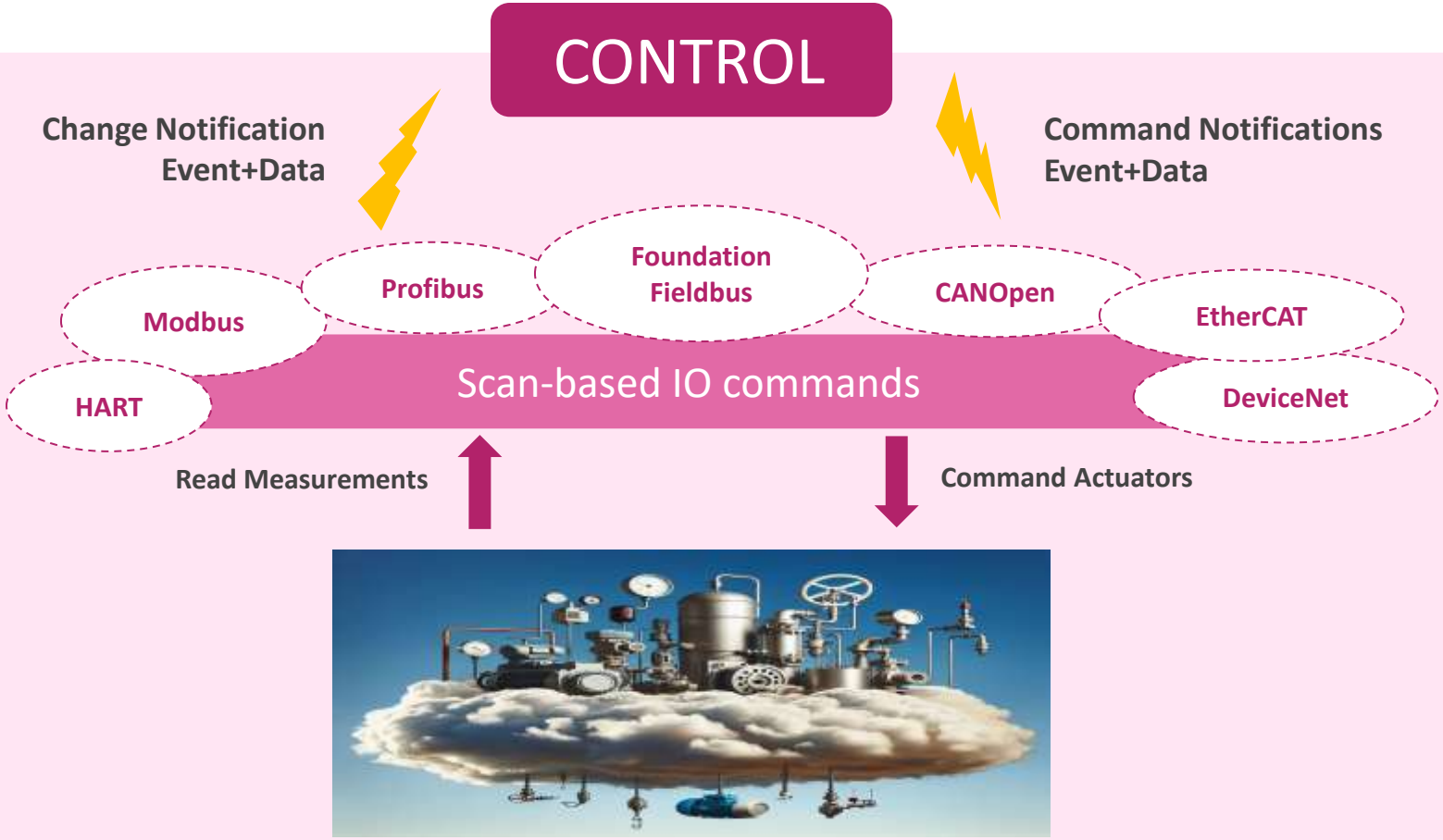

Scan-based cyclic control




IEC 61499 Event-driven control

# IEC 61499

## The technology enabler of UAO

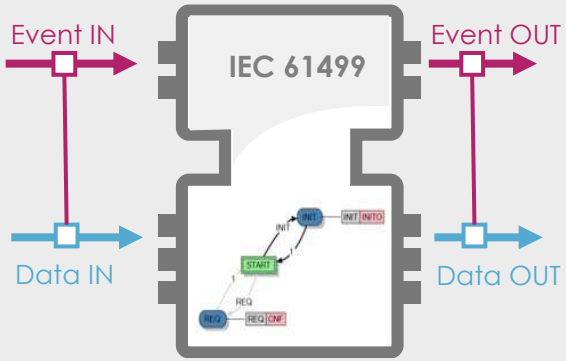



**IEC 61499 Event-driven control**

# IEC 61499

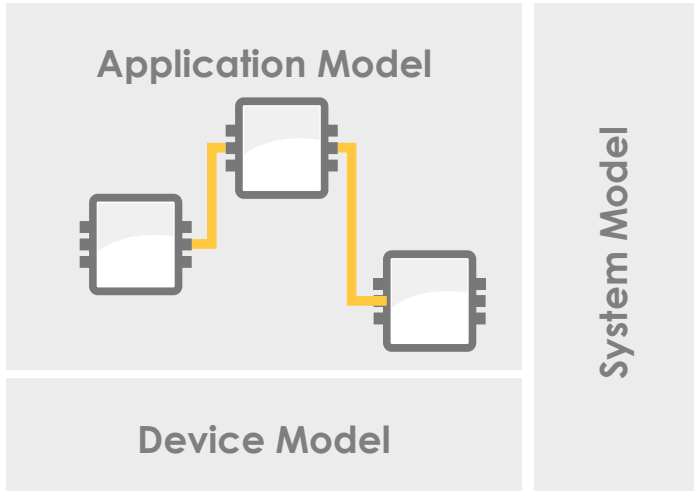
## The technology enabler of UAO

### Event-Driven Function Block



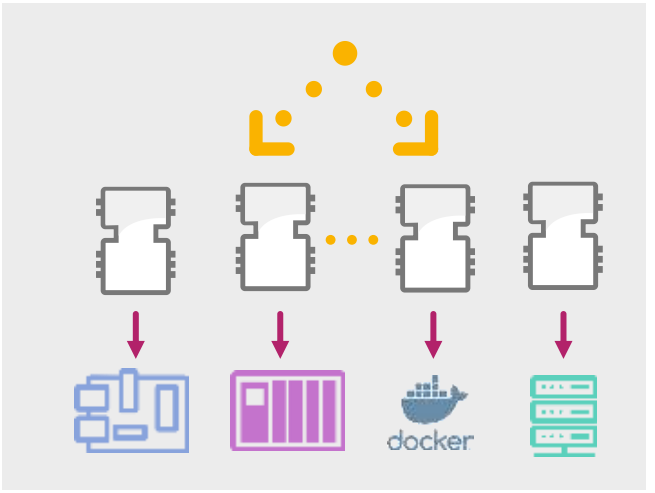

Self-contained SW component

### Software-Hardware Decoupling




Decoupling of Application Software from Hardware

### Distribution



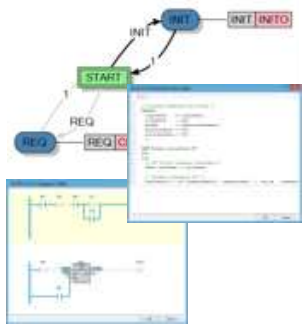

Distribution of SW components to devices

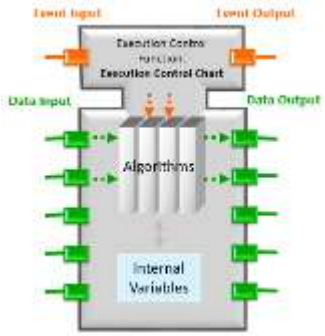
**“Plug & Produce programming using hardware-independent, proven-in-use libraries of software components“**

# IEC 61499 –
# Event Driven Function Block

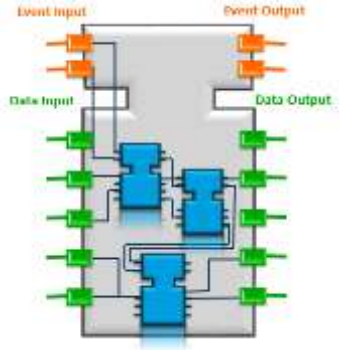
- Self-contained SW component providing functions ***thru defined interface***
- Programmed in any language
- Real-time + Right-time
- SFB: FB interface to functionality beyond IEC 61499, like comms networks, device hardware, etc.

**Basic FB**
e.g. Motor
+ Execution Control Chart
+ Algorithms (ST)

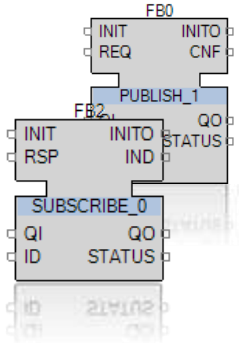


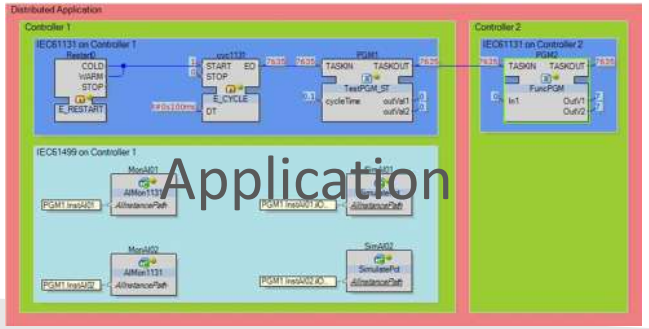




**Composite FB**
e.g. Conveyor line
Composed out of Basic FB, Composite FB, Service FB




**Service FB**
e.g. I/O access (Data, HMI, Communication …)
Provided by the System



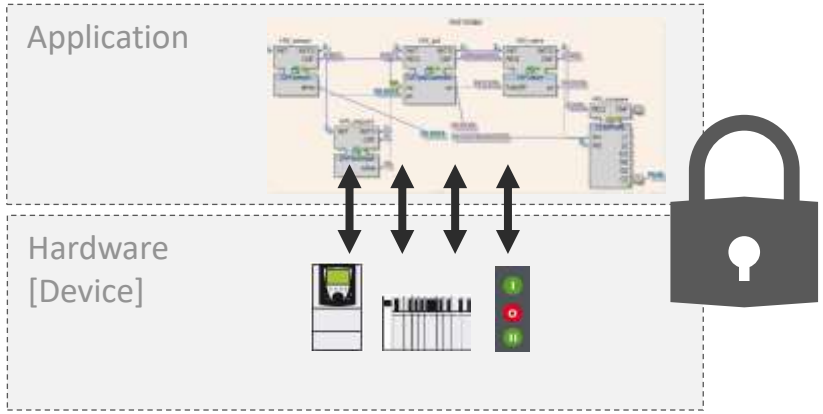



# IEC 61499 –
## Application and Device/Resource models

### Decoupling of Application software from hardware

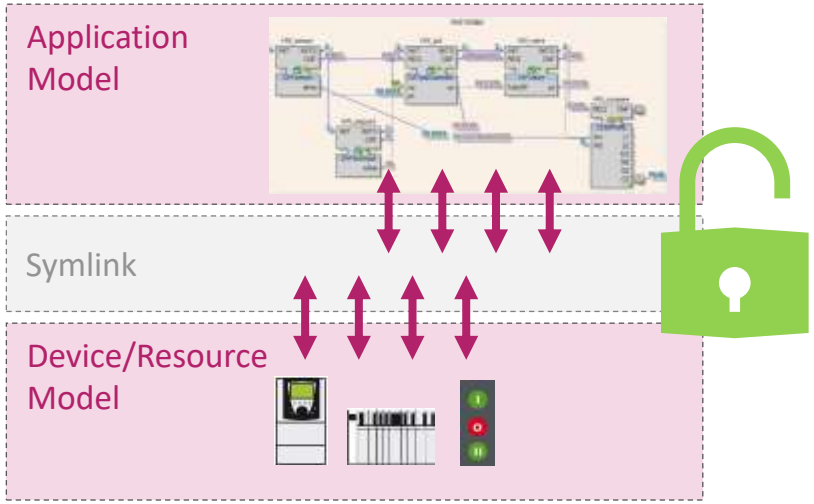
- **Application Model**
  defines how to create application using FB networks
- **Device/Resource**
  models define the compute resources on which the application will execute

**Today**
**Hardware & Application**
is tigthly linked




- Reusability is difficult
- Late modifications are challenging and costly

**Tomorrow**
**Hardware & Application**
is completely independent due to Abstraction



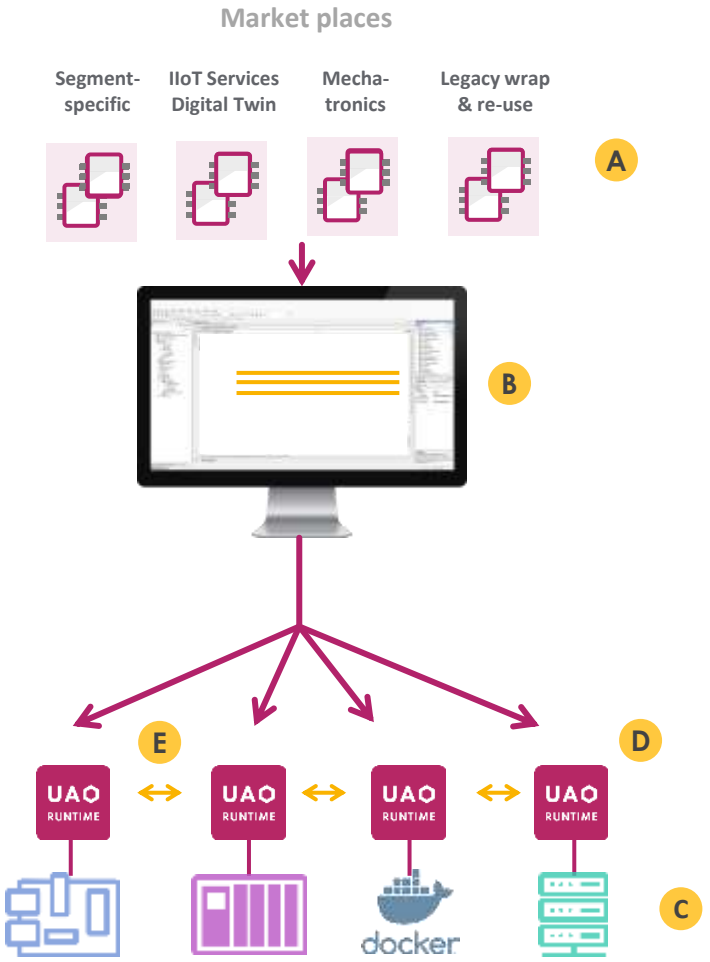

- Create applications without considering the HW where it will be deployed
- Link application and hardware at the latest possible time in the project schedule

# IEC 61499 Libraries - Plug & Produce SW Components

**Proven-in-use software components (automation apps)**

**Integrated Development Environment for IEC61499 application**
**"BuildTime"**

**Distributed control HW with embedded "RunTime"**




- A Instantiate from library
- B Program whole application
- C Select hardware topology
- D Deploy application to controllers
- E Inter controller communications generated automatically

"Write once, distribute across universal automation devices"

**Today**

Low value proprietary applications

- Costs
- Time to Market
- Flexibility
- Quality

**Tomorrow**

High value portable apps

- Costs
- Time to market
- Flexibility
- Quality

UNIVERSAL AUTOMATION.ORG

# How UAO helps you improve your KPI's

| | | Traditional objectives | | | Emerging objectives | | | |
|---|---|---|---|---|---|---|---|---|
| | | Productivity | Lower TCO | Reliability | Employee Experience | Resiliency | Flexibility | Sustainab-ility |
| Rewriting the rules of automation | Plug & Produce SW Components | Low code/ no code | | Proven-in-use application SW components | | SW re-usabiility | | Accelerate open standards (OPAF, MTP,..) |
| | Software/Hardware Decoupling | | BIC hardware- SW re-usability | | Only one automation tool to learn | Easier supply chain & obsc- olescence mgt | | |
| | Asset Centric Design (Object-Oriented) | Lower downtime/ MTTR | | | Attractive to new gen of SW engineers | | Modular process/ machines | |
| | Event/Data-Driven | Automation + IT (Digital Twin, analytics, …) | | | | | | Automation + IT (Digital Twin, analytics, …) |

Degree of impact: Low  High

# UAO on the Web

WEB | eLEARNING | Community of Practice | Frequently Asked Questions

FOLLOW US

## CONTACTS

- Raquel Torres – President
- Greg Boucaud – Chief Marketing Officer
- Sarat Molakaseema - Chief Architect Officer
- Magnum Garzillo – Key Account Manager Users
- Inna Arkhipova - Academics Program Manager
- Sejla Trakic - UAO Member Success Manager

## FLYERS

- for End-Users
- for EPC/System Integrators
- for Vendors
- for Academics

## VIDEOS

- UniversalAutomation.org (12)
- IEC 61499 (5)
- Testimonials (10)
- UAO Goes Live (5+)

UNIVERSAL

AUTOMATION.ORG