

## Open Process Automation (OPA): Industry Adoption

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> 2025 Foxboro Southeastern User Group Chatanooga, TN 19-20 Feb 2025



### Outline

#### **Motivation and Vision**

#### Journey to Solution: Open Process Automation

- Industry standard
- Business ecosystem
- $_{\circ}~$  Conformance certification

#### Industry adoption: Operating company projects

#### Coalition for Open Process Automation (COPA) and COPA Control System

- COPA: Who, What, When, Where
- COPA Control System: Technical characteristics
- Initial and Total Cost of Ownership case studies
- Lifecycle support

#### **Conclusions and Recommendations**



### The Business Problem

High-cost, no-return projects for control system replacements

End User pain points and value opportunities:

- lack of interoperability and inability to reuse their control applications between systems from different suppliers
- excess cost of system upgrades due to close couplings between components
- barriers to value generation from introduction of new technology hardware or software
- after-the-fact, **bolted-on cybersecurity**

## Vision for Solution



#### Current DCS architecture

#### A standards-based open, secure, interoperable process automation architecture (OPA)

#### **OPA** reference architecture

External



- Proprietary hardware, interfaces and networks
- Vendor-controlled software access

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DCS

• Cybersecurity not intrinsic: bolted-on, not built in

- OT Data Center Enterprise IT Data Centers / Cloud Non O-PAS Business Virtual DCN Platform Environments DCN OCI Legend O-PAS Conformant Component O-PAS Connectivity Framework (OCF) Non O-P/ Virtual DCN DCN DCN Virtual APP DCN Safety. OCI OCI Electrical APP & Machine OCI - O-PAS Communication Interface
  - Industry standard interfaces and networks ٠
  - Interoperable hardware and software ٠
  - Open software access ٠
  - Designed-in cybersecurity



### **Open Process Automation Forum of The Open Group**

Define the O-PAS<sup>™</sup> standard Develop the **business ecosystem** Certify **product conformance** 

- Founded Nov 2016
- Currently 100 member companies
  - $_{\circ}$  19 operating companies
  - $_{\circ}~$  6 of 7 global DCS companies
  - Hardware/software suppliers
  - System integrators
  - $\circ$  Universities
  - o Others







## **O-PAS Standard and Quality Attributes**

	O-PAS Part	Subject matter	Referenced standards	Quality Attributes
	Part 1	Technical architecture	IEC 62264 (ISA 95)	Quality Attributes
	Part 2	Security	IEC 62443 (ISA 99)	
	Part 3	Profiles	n.a.	Interenerability
	Part 4	Connectivity framework	IEC 62439 (IEEE 802.3, 1588) IEC 62541 (OPC UA)	Interoperability
	Part 5	System management	DMTF (Redfish)	
	Part 6 (.16)	Information and exchange models	IEC 62714 (AutomationML) IEC 62682 (ISA 18) IEC 61131 IEC 61499	Availability
	Part 7	Physical platform	"whitespace", PCMIG	Manageability
	Part 8 (future)	Application portability	containment	
	Part 9 (future)	System orchestration	TOSCA	
	2019 .			2023 - 2024
In	teroperability	<b>Configuration Portability</b>	<b>Configuration Portability</b>	Configuration Portability Application Portability
0-P/	AS <sup>™</sup> Version 1.0	O-PAS <sup>™</sup> Version 2.0	O-PAS <sup>™</sup> Version 2.1 Preliminary	O-PAS <sup>™</sup> Version 2.1 O-PAS <sup>™</sup> Version 3.0 Final
18 Feb	o 2025		2025 Foxboro SE User Group	( <u>link</u> ) 6 of 25



## **OPA Business Ecosystem**



#### **Key publications and activities**

- OPA Business Guide: Value Proposition and Business Case (<u>link</u>)
- Marketing and Outreach: "Industry Adoption" theme
  - $_{\circ}~$  End User Caucus meetings
- Liaison relationships
  - $_{\circ}~$  OPC Foundation
  - $\circ$  ISA
  - NAMUR
  - Control System Integrations Assn.
  - $\circ$  Others
- Interoperability events ("plugfests")
- O-PAS Adoption Guide (link)



## **O-PAS Conformance Certification**

#### **Conformance certification started 3Q24**

#### **Certification Wave 1a scope:**

- DCP-001 Distributed Control Node Platform
- NET-F-001 Single Ethernet to Ethernet
- NET-F-002 Single Ethernet Peer to Peer
- OCF-001 OPC UA Client/Server
- SEC-F-001 IEC 62443-4-2 Cybersecurity
- OSM-002, -003 Redfish (system management)
- **Verification labs**: OPC Foundation, ISA Security Compliance Institute (ISCI), ERDiLab, Others TBN

### **Registry** of certified products



## Industry Adoption of OPA

- Test beds and pilot projects
- Production systems



## Industry Adoption: End User OPA projects

Company	Test bed	Prototype	Field trial
ExxonMobil			$\checkmark$
BASF		$\checkmark$	
Georgia Pacific		$\checkmark$	
Saudi Aramco	$\checkmark$		
Dow Chemical		$\checkmark$	
Equinor		$\checkmark$	
Shell	$\checkmark$		
Petronas		$\checkmark$	
BP		$\checkmark$	
<b>Reliance Industries</b>	$\checkmark$		



## ExxonMobil's OPA Field Trial "Lighthouse"

#### ExxonMobil's 3<sup>rd</sup> OPA system build

#### Systems integration by

- $_{\circ}~$  Lockheed Martin
- $\circ \ \text{Wood}$
- $_{\circ}$  Yokogawa

#### Test bed components

**Test bed facility** (Spring, TX)

#### Field trial statistics:

- $_{\circ}~$  Manufacturing facility in Louisiana
- $_{\circ}~$  Replace DCS and several PLCs
- Single operator, single console operation
- ~1,000 I/O; 100+ control loops
- Commissioned in Nov 2024
- <u>Corporate press release (10 Feb 2025)</u>







## **BASF demonstrator**

#### Demonstrate

 $\circ$  OPA

- Module Type Package (MTP)
- NAMUR Open Architecture (NOA)

#### **Components:**

- DCN: Phoenix Contact
- $\circ$  OCF: OPC UA
- ACP: HPE computer with WindRiver Titanium hypervisor
- Software: ABB 800xA
- Valves: Samson

#### Systems integration by

- $\circ$  TU Dresden
- $\circ$  CodeWrights





## Georgia Pacific "demo board"

**Portable unit** for demonstrations at multiple paper mills

#### **Components - DCNs:**

- $\circ$  Rockwell
- Phoenix Contact
- $\circ$  Siemens
- $\circ$  Schneider Electric
- $\circ$  Stahl
- $_{\circ}$  Yokogawa

#### Systems integration by

- $_{\circ}$  Hargrove
- $\circ$  Siemens





### Dow Chemical MxD Open Architecture testbed

Plug & play **interoperability across vendors** and technologies

**Demonstrate OPA computing framework** to deploy open automation and digital twin functions

With ADI, Univ. of Michigan, and Siemens





## Equinor, BP, others: COPA QuickStart

#### Coalition for Open Process Automation (COPA)

- 15 OPAF member companies;
  Separate from OPAF; Span ecosystem roles
- Organized by CSI and CPLANE.ai
- ASRock, Burrow Global, CODESYS, EOSYS, Enterprise Transformation Partners, Inductive Automation, Intel, Nova SMAR, Phoenix Contact, QUEST Global, Stahl, Supermicro, Wood

**QuickStart**: small functional system and training program

**Control Platform:** system for piloting or on-production 18 Feb 2025

#### Architecture



Based on O-PAS Version 2.1 industry standard from the OPA Forum of The Open Group

#### System



Multi-vendor hardware and software system integrated by CSI and CPLANE

## Coalition for Open Process Automation (COPA)

## **Coalition for Open Process Automation**



#### Purpose: Catalyze OPA ecosystem and adoption

- COPA is independent of OPA Forum
- Organized by CPLANE and CSI in 1Q2022
- 15 member companies currently; Members of OPA Forum; Span the OPA business ecosystem
- COPA QuickStart (system, training)
- COPA Control Platform





## **O-PAS system building experience - COPA**



## COPA 500 production systems



# 1.) Texas A&M: small modular nuclear reactor

## 2.) Oil & gas supermajor: terminal facility



## Control System







## **COPA Control System characteristics**

### "Field-proven components in an open architecture"

- Decouple IO and Compute
- Interoperable data communications using OPC UA
- Decouple software from hardware
  - O-PAS Connectivity Framework (OCF) for interoperability
  - High availability (software-defined redundancy) for unplanned outages
  - Zero-downtime hardware/software upgrades
- Portable, reusable applications via industry standard languages (IEC 61131) and virtualization/containers
- Cybersecurity using role-based access, authentication, encryption, etc.
- IT-proven, automated systems management and orchestration
- Business value creation with third-party technology insertion



## Benefits: Initial- and Total Cost of Ownership

#### **Cargill edible oils process**

- Greenfield plant
- 14,000 I/O; 4-20mA HART
- Redundant network and DCN hardware
- IEC 62443 Security Level ≥ 2

<u>Case study 1</u>: EPCcalculated initial- and 25yr TCO

<u>Case study 2</u>: Cargillcalculated TCO



18 Feb 2025



## Economic case study results

#### 1.) Wood-calculated comparison: COPA v. DCS<sub>1</sub> (normalized to DCS<sub>1</sub> TIC)

Costs (thousand USD)	DCS <sub>1</sub>	СОРА	COPA/DCS <sub>1</sub>
Hardware & System software	0.272	0.130	48%
Engineering & Construction (detail engineering, install, commission)		0.772	106%
Total Initial Cost		0.902	90%
25-yr Total Cost of Ownership (excl. initial cost)		0.759	53%

2.) Cargill-calculated comparison: COPA v. DCS<sub>i</sub> (i = 1,2,3) (normalized to COPA TCO)

Costs (thousand EUR)	DCS <sub>1</sub>	DCS <sub>2</sub>	DCS <sub>3</sub>	СОРА
25-yr Total Cost of Ownership (incl. plant downtime)	3.39	2.52	2.64	1.00
COPA/DCS <sub>i</sub>	29%	40%	38%	



## **COPA Control System lifecycle support**



- Systems Integrator: During project stage, integrates entire O-PAS system as the single point of contact and primary responsibility for system performance.
- Service Provider: During post-commissioning period, provides on-going maintenance and upgrades.

## Conclusions



## **Concluding remarks**

#### OPA is transformative

• Addressing root causes to reduce total cost of ownership and enable innovation/value generation

#### **Business case** for OPA **is compelling** – 60-70% TCO savings

#### OPA Forum is End User driven

**Industry adoption** progressing with first-mover users, suppliers, & system integrators

- At least 10 OPA pilot projects
- RFIs and RFPs for OPA production systems being issued
- Production systems in service ExxonMobil "Lighthouse"

#### **COPA** is **leading O-PAS commercialization**

#### **COPA Control System is ready for production in 2025**

# Backup



## Shell test bed

#### Laboratory investigation of O-PAS greenfield integration with brownfield





## Petronas pilot system

#### 200 I/O system in Upstream training facility

#### Why is PETRONAS developing OPA Testbed? **Testbed Deployment and Capability Planning** What is OPA What is OPA Test Bed Project · OPA system is a standard-based open secure, Objective: interoperable process automation architecture where Q3 - 2022 Q4 - 2022 To demonstrate functionality of OPA as a Q3 -2022 End Users will benefit from the choices of best-in class viable DCS-of-future technology Application. Interoperability, interchangeability, 日前 Conventional or Legacy DCS are closed and proprietary Q1 & Q2-2022 configuration portability, application system which uses propriety hardware, interfaces and Module Handover portability. Site networks with Manufacturer-controlled software access. To prepare & upskill internal resources for Development Installation & Handover of future adoption of OPA technology. Collaboration Start testbed to INSTEP FAT **Current DCS architecture OPA** reference architecture Upskilling of INSTEP. Testing Agreement staff for module Test Bed **Factory Acceptance** SI Partner & Vendors: Installation, development & Start Test for OPA System Signing Development Yokogawa, Phoenix Contact, ASRock, delivery. Awarded to Yokogawa at YKM commissioning & Design, Engineering & Signing collaboration Schneider Electric, STAHL Testing of OPA Procurement of the agreement between system at UDTP Test Bed PETRONAS & Location of Testbed: ExacnMobil UDTP Plant INSTEP Terengganu Completed matany bandurana, interflatana and 200 I/O (Hardwired & Soft Signals) Planned Intendor-controlled soft-are access We are here! Security roll internet, Solled-on, not look in PETROMAS A PETRONAS

## **COPA QuickStart unit**





#### Software Components

Supplier	Software Component
Inductive Automation	Historian
Inductive Automation	HMI & Alarms
CPLANE.ai	Systems Management
Canonical & Intel	Virtualization & OS
CODESYS	IDE
CPLANE.ai & Intel	Orchestration
Canonical & CPLANE.ai	Software services
CSI	Model Predictive Control
CODESYS, SMAR &CSI	61131 Regulatory Control
ASRock, VECOW, Supermicro	Redfish
Phoenix Contact & Stahl	OPC UA & Redfish
Phoenix Contact & Stahl	4-20 mA <-> OPC UA
VP Process & CSI	Simulation



## **COPA System scales up and down**

