Solution Brief
Manufacturing

intel.

Software Defined Industrial Automation System

A modular, AI-ready solution unifying IT and OT with high availability, flexible infrastructure, software-based control, and IEC 61499-compliant.

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Acknowledgement

IEC 61499 and OPC-UA are referenced as industry standards. For more information, refer to the official documentation provided by their respective governing bodies.

Executive Summary

Intel, in partnership with Schneider Electric*, Red Hat*, and Hewlett Packard Enterprise (HPE)*, introduces a Software Defined Industrial Automation System that modernizes legacy control systems. Built on open standards and general-purpose compute, the solution enables real-time control, high availability, and AI integration at the edge. It supports dynamic workload management, protects existing investments, and offers manufacturers a scalable, flexible, and future-ready platform for industrial automation.

Introduction

Legacy industrial automation systems have reliably served manufacturers for decades. They offer reliability, efficiency, and predictable performance. Yet, they are rigid and hard to upgrade—making it difficult to integrate new capabilities or adapt to changing requirements. As fixed-function systems, their ability to adapt to new use cases is limited. Lastly, they are typically provided by a single vendor, which restricts the ability to integrate best-in-class capability from multiple vendors and keep up with the performance cadences as new requirements emerge.

That's why manufacturers are demanding a new flexible industrial automation architecture which will carry industrial automation systems into the future. We generically call this next generation solution a *Software Defined Industrial Automation System*. A *Software Defined Industrial Automation System* is anchored on modern technologies, which are foundational to the IT industry like containerized workloads, virtualization and orchestration. They are built around the concept that general-purpose computers and general-purpose operating systems/software have evolved to the level of performance and real-time capability, dependability and scalability that are demanded by manufacturing processes. A graphical representation of this transition is shown in Figure 1 below.

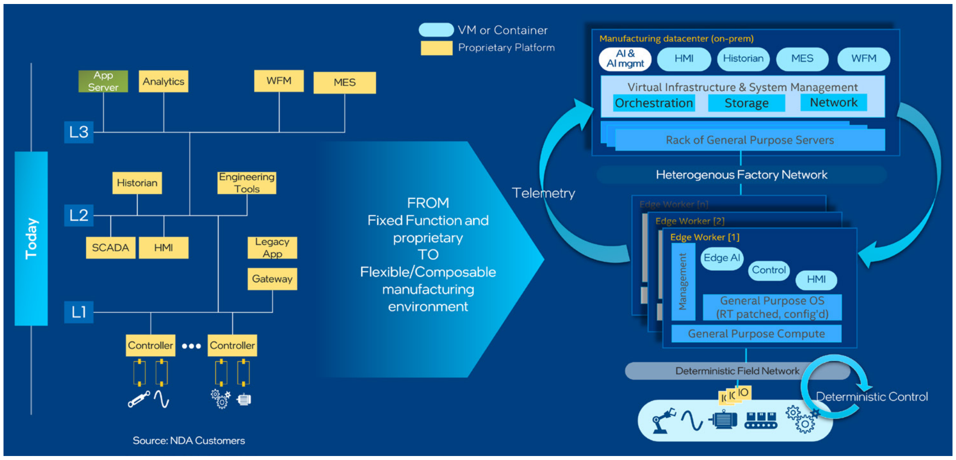

Figure 1. Evolution of Industrial Automation

Advanced IT technologies alone aren't enough. A viable system must still meet manufacturing's tough requirements: **deterministic** real-time, **high availability** of Process Control, Process Data collection through a **failure event**, and **rugged performance** in constrained environments. All these without compromising on Size, Weight and Power (SWAP) Formfactors (FF). This solution satisfies these needs while also unlocking benefits such as workload consolidation, disruption avoidance, and dynamic upgrades to meet evolving performance requirements.

The solution meets legacy requirements for Deterministic Control and High Availability. It also enables new use cases such as disruption avoidance, workload consolidation, and dynamic system upgrades. Additionally, the described solution serves as a vehicle to host applications ranging from virtual HMI, software PLC to Edge AI.

The *Software Defined Industrial Automation System* described within is not just slideware or prototype software. This solution is built with commercially available components from Intel, Schneider Electric, Red Hat, and Hewlett Packard HPE.

System Architecture and Technologies

The system architecture for this solution is modular and software-defined, enabling scalable deployment across a range of industrial environments. System architecture with core components is presented in Figure 2.

Controlled Process

This represents the specific manufacturing workflow, typically proprietary to the manufacturer. Using Schneider Electric's *EcoStruxure Automation Expert* (EAE) and the IEC 61499 standard, the process logic is modeled graphically. This digital model captures control flows, dependencies, and system behavior—ensuring the process remains portable, verifiable, and upgradeable.

IO Devices or Gateways

These components interface with physical actuators and sensors on the production floor. They support industrial automation protocols and expose process data via the *Open Process Control Universal Automation* (OPC-UA) standard. This decouples the physical process from the field network and allows manufacturers to choose devices from multiple vendors.

Edge Workers (Distributed Control Nodes – DCNs)

DCNs are Intel-based industrial PCs running real-time workloads. Technologies like *Time Coordinated Computing* (TCC) and *Cache Allocation Technology* (CAT) enable fine-tuned performance for deterministic control. These nodes can host software PLCs, manage OT functionality, and contribute to workload sharing across the cluster.

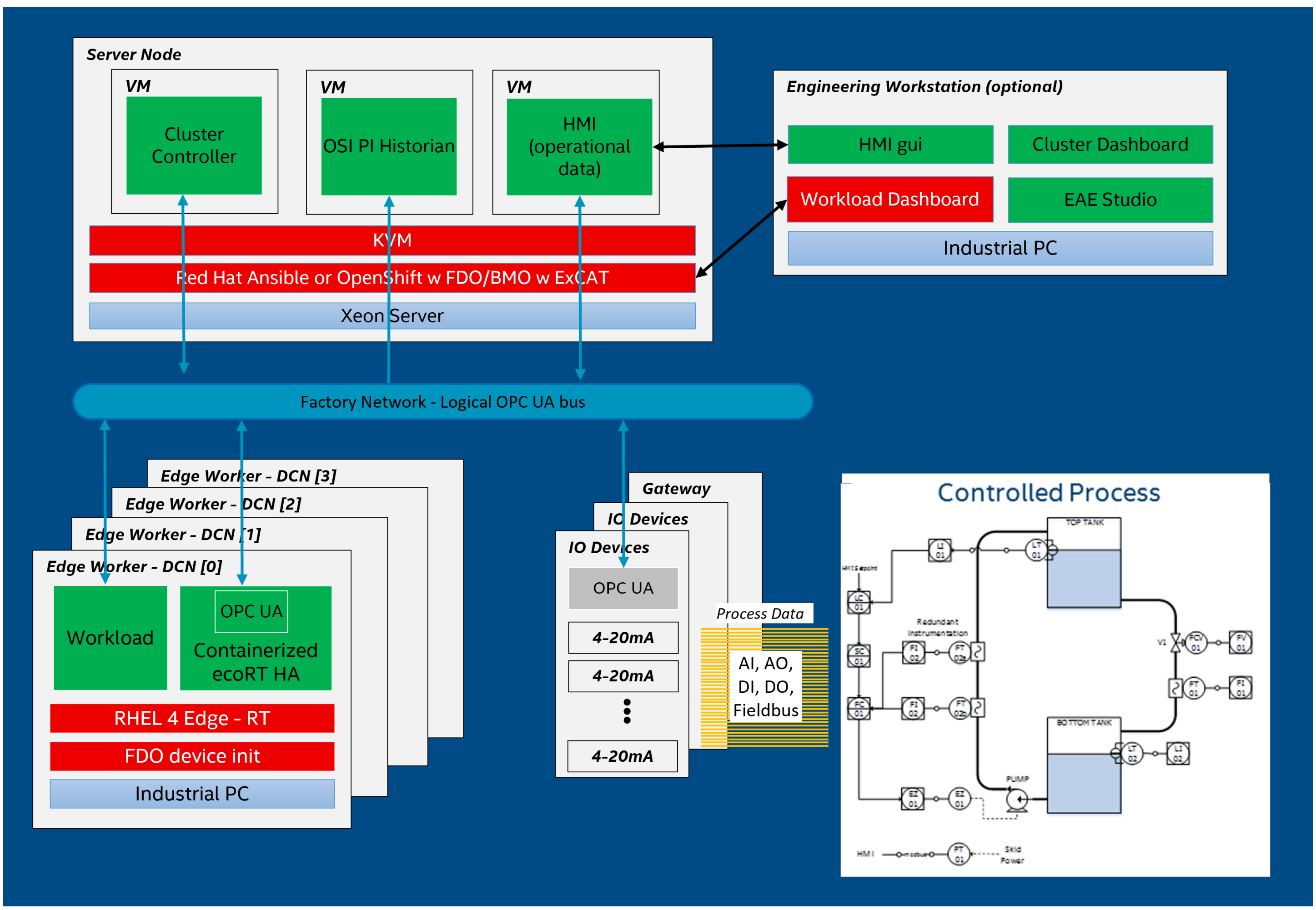

Figure 2. System Architecture

Operating System and Control Software

The system runs on Red Hat® Enterprise Linux® (RHEL) and uses high-availability control software from Schneider Electric to ensure deterministic execution, fault tolerance, and reliable process data collection.

Server Nodes (On-Prem Data Center)

Server nodes support orchestration and centralized functions. They host virtual machines for cluster control, workload distribution, and system monitoring. Intel-based HPE servers provide the compute backbone, while management tools like Red Hat® Ansible® Automation Platform or Red Hat® OpenShift® manage the orchestration and resilience of the entire cluster.

Workload Management

A key value of this software-defined system is that all functions —from control to AI—are managed as workloads within a unified cluster. Assignment of workload to computer is determined by system policies that consider real-time, functional, and resource constraints.

The mapping from the IEC 61499-controlled process model to the execution environment is flexible. Within basic constraints workloads can be dynamically reassigned to optimize performance or accommodate new use cases like edge AI, predictive telemetry, or data consolidation.

Key Advantages of the Solution

This solution delivers significant benefits to manufacturers by directly addressing the limitations of existing brownfield systems.

Since the process flow is initially defined using an IEC 61499-compliant model, the manufacturer's core intellectual property is captured and protected independently of how or where it is deployed. This digital model can also be used in the future to test and validate production process improvements.

The solution is built on open standards, such as OPC-UA, for exchanging process data over Ethernet. This approach expands the choice of device vendors, enabling greater flexibility for manufacturers.

By integrating and encapsulating established OT methods, the solution safeguards previous investments in PLC programming and integration of Supervisory Control and Data Acquisition (SCADA) systems.

Using general-purpose computing hardware allows the system to evolve over time, keeping pace with changing technologies. Since every function is treated as a managed software workload, system management becomes simpler. Additional workloads—such as telemetry, data annotation, or AI at the edge—can be easily added or scaled.

The adoption of proven IT manageability tools ensures high availability and operational continuity. Software workloads can move between nodes seamlessly, enabling maintenance or hardware replacement without interrupting the controlled process. This same mechanism supports cybersecurity updates and hardware upgrades.

Ultimately, manufacturers gain the flexibility to balance system cost, performance, and fault tolerance according to their needs.

Conclusion

This solution demonstrates how IT/OT convergence and edge-based distributed control can modernize industrial automation. By consolidating real-time, AI, and general-purpose workloads on Intel-based platforms, manufacturers can improve performance, adaptability, and time to market while maintaining high availability and low total cost of ownership (TCO). Intel silicon-based edge platform enabled with TCC helps the industry achieve these goals.

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