

Solution Brief

Industrial Edge Platform for
Distributed Control Systems



Red Hat Improves Manufacturing Operations, Scale, and Innovation with an Industrial Edge Platform

A solution built with Intel-based platforms—including Intel® Edge Controls for Industrial—delivers open source industrial automation to the manufacturing shop floor



As the complexity of manufacturing processes and product design increases, manufacturers are seeking to improve the flexibility of manufacturing systems, increase the availability of manufacturing equipment, and reduce costs. Manufacturers have historically been constrained from innovating industrial control systems that are tethered to legacy hardware. However, the global shift toward smart factories, or software-defined factories, is helping to amplify the speed at which manufacturers can now innovate.

To support this innovation, Red Hat and Intel are collaborating to bring a modern approach to building and operating industrial automation and control systems, allowing customers to develop holistic solutions that span from real-time shop floor control to full information technology (IT) manageability. Built with Red Hat® Device Edge, Red Hat® Ansible® Automation Platform, Red Hat® OpenShift®, and Intel-based platforms—including Intel® Edge Controls for Industrial (Intel® ECI)—this industrial edge platform is designed to give customers real-time control in a flexible and managed environment.

Providing an edge-ready, software-centric approach to operational technology (OT), this solution enables manufacturers, machine builders, and system integrators to automate previously manual tasks for commissioning and updating industrial control systems at scale. The solution uses IT standards and automation techniques that run on rugged, industrial-hardened computers and a leading, enterprise open source operating system. Other benefits include greater choice for data gravity, edge-to-cloud-style architectures, and improved overall equipment efficiency.

Third-party PLC and control applications

Intel and Red Hat industrial platform

Tools and test suites to enable real-time performance

Red Hat operating system optimized for real time

Intel® processor for industrial use cases with HW support for real-time compute

intel.
EDGE CONTROLS
FOR INDUSTRIAL

Figure 1: The Intel and Red Hat industrial platform is optimized for third-party programmable logic controllers (PLCs) and control applications.

Challenge: Modernizing legacy industrial control systems

Fixed-function devices based on proprietary hardware and software, along with organizational silos, have slowed the pace of innovation in manufacturing processes. To reduce operating costs and downtime, industrial control systems must be reliable, flexible, scalable, portable, and easy to deploy. They must support best-in-class products with a guarantee of system interoperability without compromising agility or security, and they must run without failure and require minimal downtime for repairs or updates.

Solution: Building comprehensive next-generation control systems

To meet the needs of modern manufacturing, next-generation control systems will require a holistic solution—one that entails real-time shop floor control, artificial intelligence/machine learning (AI/ML), and full IT manageability. These systems will need to deliver a managed, real-time, deterministic edge foundation for modernizing industrial control system deployments. The system architecture will need to be loosely coupled using portable microservices and should support workload consolidation. Additionally, the introduction of AI and vision at the edge—with AI intercepting the real-time control loop—will drive the need for greater compute at the edge. In short, a fully defined and functional next-generation control system will need to provide robust functionality, including:

- **Fully integrated, real-time capabilities**—from silicon to software—that provide predictable performance of time-sensitive, industrial automation use cases.
- **Advanced management and network automation** for on-premises system deployment and management without heavy-handed resource usage and tools based on open standards for simplified industrial network creation and management. Open standards-based solutions can replace complex, costly, and difficult-to-maintain integration processes with plug-and-play interoperability.
- **Scalability and flexibility** through a composable platform approach with isolated runtimes based on a microservice architecture that facilitates more-portable, scalable control and maximizes adaptability.
- **Uninterrupted operations** supported by simple, lower-cost, self-healing systems and integrated high-availability and redundancy attributes.
- **Simplified AI workload integration** with the ability to take an AI workload and run it next to a control workload. This will help simplify hardware complexity and enable AI to improve product quality, system uptime, and maintenance needs more easily.
- **Enhanced cybersecurity posture** by removing human error elements with automated patching and updates, an immutable operating system plane, and a platform built on hardened, production-tested components.

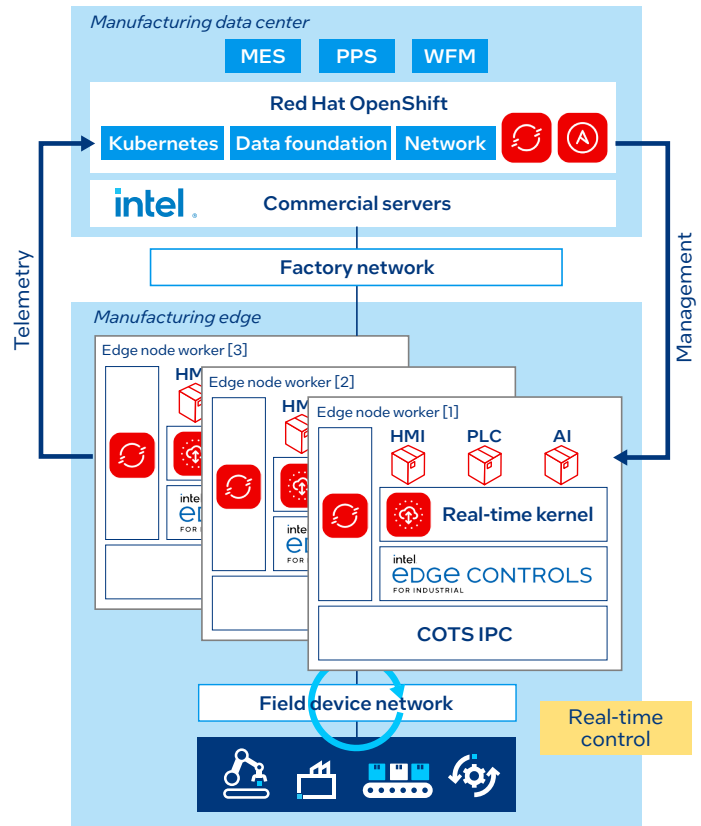


Figure 2: An open industrial edge platform enabled by Red Hat and Intel simplifies and enhances your manufacturing workloads.

An open platform for industrial automation at the edge

Intel and Red Hat have taken the first steps to mature industrial controls technologies by integrating Red Hat Device Edge, Ansible Automation Platform, and OpenShift with Intel-based platforms, including Intel ECI, to deliver an open, industrial edge platform (represented in Figure 2) that can reliably execute control functions.

The flexibility of a control system is lost if industrial requirements, including thermal and deterministic constraints for real-time systems, are not satisfied. To address this, the current version of the Intel and Red Hat industrial edge platform focuses on satisfying the real-time compute requirements of edge node workers, as shown in the manufacturing edge section of the diagram.

Real-time control at the edge

The solution incorporates fully integrated, real-time capabilities—from silicon to software—to support industrial automation for predictable performance. The platform delivers a real-time kernel that provides lower latency and reduced jitter, helping applications run with greater reliability and the ability to self-heal with application/workload liveness and health checks. It also automates previously manual industrial automation tasks.

To help simplify hardware and software integration, the platform is built on open standards and community-driven innovation. Additionally, Red Hat’s industry-leading enterprise developer support enables IT teams with best-in-class developer tools to help improve deployment consistency, regardless of deployment model or integrator, and further reduces choice paralysis around modern developer tooling. Red Hat also provides industrial-grade, mission-critical support to complement the do-it-yourself (DIY) aspects of adopting an open source platform.

How it works

To prove the applicability for real-time use cases, Intel and Red Hat have made a set of tools, benchmarks, and real-time optimizations available. These are designed to reduce compute cycle time jitter (processing time variability), improve demand response latency (the industrial controller’s responsiveness to external events), and improve cycle time performance (the time required to run specific instructions).

Compute cycle time jitter

By combining Intel and Red Hat real-time tunings and optimizations with the Intel-provided Caterpillar tool, users can apply Intel® Cache Allocation Technology (Intel® CAT) and Intel® Time Coordinated Computing (Intel® TCC) to reduce compute cycle time jitter.

Access the [Intel ECI Caterpillar benchmark](#), certified and listed in the Red Hat Ecosystem Catalog.

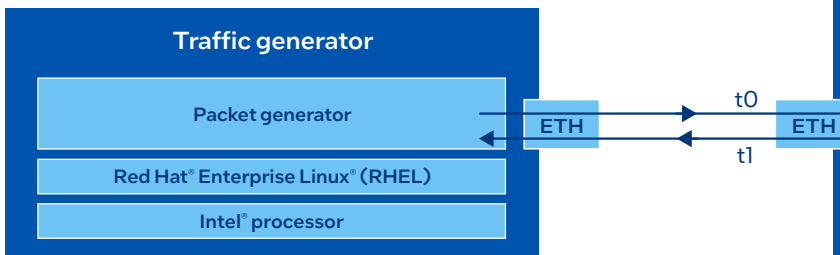


Figure 3: A simplified view of testing the demand response latency of the individual controller.

Demand response latency

The Intel-developed Real-Time Compute Performance (RTCP) benchmark—run on Red Hat® Enterprise Linux® with the Data Plane Development Kit (DPDK)—is used to measure system latencies and provide a performance indicator for demand response latency. A simplified view of this benchmark is shown in Figure 3.

Access the [Intel ECI RTCP-DPDK benchmark](#), deployable on Red Hat.

Cycle time performance

A toolkit based on a third-party containerized programmable logic controller (PLC) allows users to evaluate cycle time performance. This benchmark is a multinode test and uses Open Platform Communications Unified Architecture (OPC UA) client/server transactions, a cross-platform, open source data exchange standard for controller-to-IO communication. OPC UA is becoming increasingly common at the fieldbus layer and is specified by Open Process Automation Standard (O-PAS). A simplified view of this benchmark is shown in Figure 4.

For testing purposes, this solution used a [third-party runtime control environment benchmark](#),¹ deployable on Red Hat.

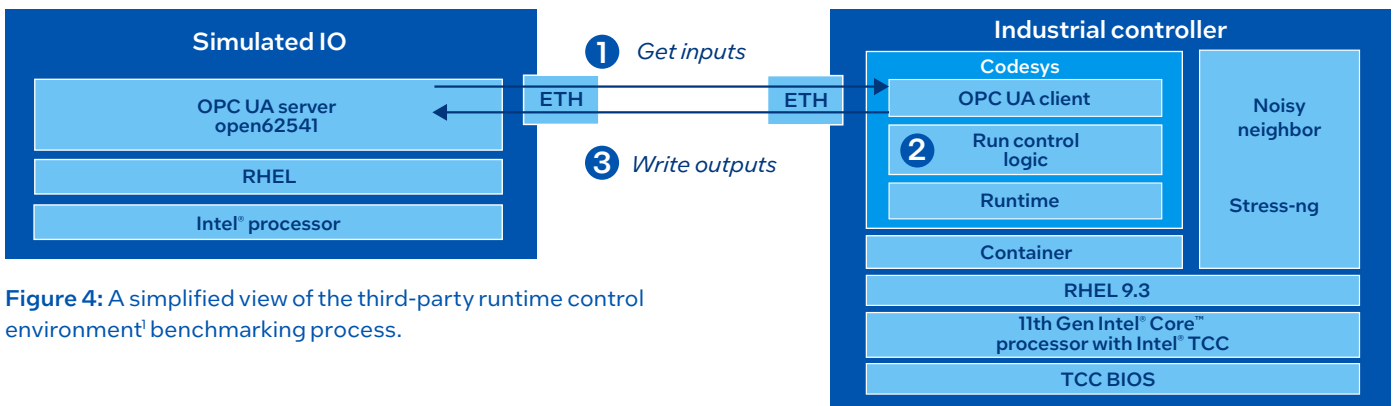


Figure 4: A simplified view of the third-party runtime control environment¹ benchmarking process.

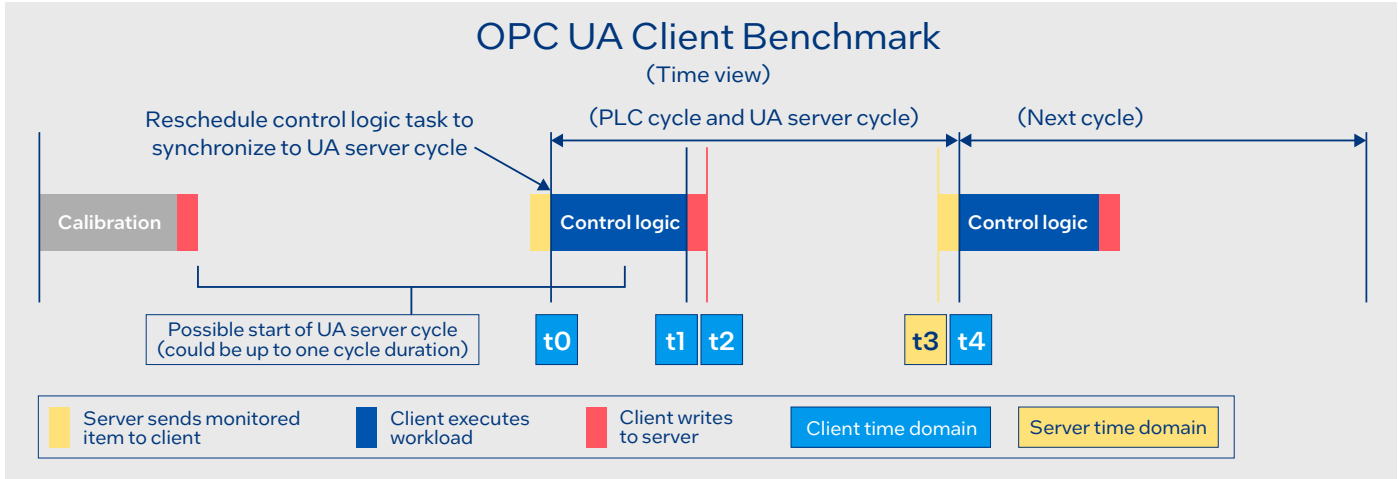


Figure 5: OPC UA client benchmarking timing diagram.

Conclusion: Transforming industrial automation with Intel and Red Hat

Transforming industrial automation from fixed function, proprietary systems into a flexible and composable manufacturing environment requires innovative, software-defined solutions. Intel and Red Hat have built an open, edge-ready platform with foundational building blocks that enable innovative development in industrial controls. Coupling Red Hat Device Edge, Ansible Automation Platform, and OpenShift with Intel-based platforms, including Intel ECI, this industrial edge platform is reliable, simple to maintain, and makes it easy to deploy modern controls.

The platform is based on a proven foundation that provides stability, enhanced security, and flexibility to help drive innovation at the edge while delivering high value. With this platform, solution providers can enable and certify turnkey solutions backed by a growing community of independent software vendors (ISVs), system integrators (SIs), and hardware vendors. Core code transparency and a clear road map and release cycle help take the guesswork out of future releases and feature availability.

Learn more

Learn about the Red Hat Device Edge platform for operational consistency across workloads at the edge at redhat.com/en/technologies/device-edge.

Discover how the Red Hat Ansible Automation Platform benefits end-to-end automation at redhat.com/en/technologies/management/ansible.

Explore Intel Edge Controls for Industrial, Intel’s software reference platform for industrial controls use cases, at eci.intel.com/docs/3.1/eci.html.

About Red Hat

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Notices and disclaimers

1. For this test, the CODESYS OPC UA client was leveraged.

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