Leveraging local Intelligence to CERN Industrial Control Systems through Edge Technologies

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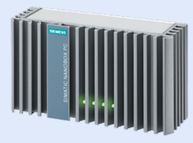
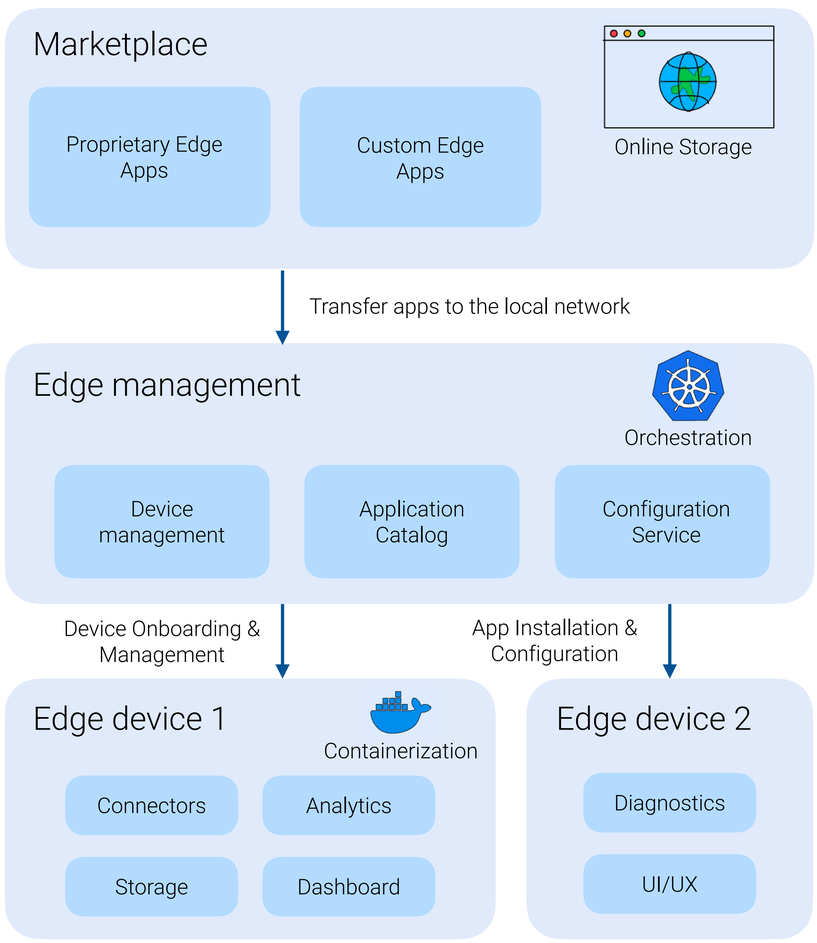
TUPDP102

Introduction

Enhancing Industrial Control Systems by integrating advanced control algorithms presents substantial challenges. One of them is safeguarding independence between core control processes and algorithms. Another is bridging the developmental tool divide between control engineers and data scientists. Industrial Edge Computing is a solution to navigating these challenges by deploying algorithms close to the process and employing prevalent programming languages and IT tools.

Technology / Criteria	IPC	Edge	AI PLC Extension	Multi-process controllers
Form factor				
Device & Software Management	Manual Setup	Dedicated system	PLC software	Manual Setup
Connectivity	Ethernet, Serial	S7, OPC UA	Ethernet, USB	Ethernet, OPA UA
IT tools & languages	Unrestricted	Container apps	MicroPython	C++, Python

Comparison of different technologies to deploy advanced control algorithms close to the process



Components of Industrial Edge Ecosystem

Industrial Edge Ecosystem

The industrial edge ecosystem enables near real-time data processing close to the data source. Key components of the ecosystem include:

Edge devices: Bridges physical equipment with IT systems.

Edge applications: Executes specific tasks like data pre-processing and analytics on Edge devices.

Edge management: Oversees operations and resource allocations while enabling device network integration.

Online marketplace: Facilitates the purchase and transfer of edge applications to local edge management systems.

Model Predictive Control on Edge

For an air handling unit at CERN, the MPC algorithm deployed on a Siemens industrial edge ecosystem has the following setup:

PLC-Edge communication occurs via two edge applications, - S7 Connector and IE Databus.

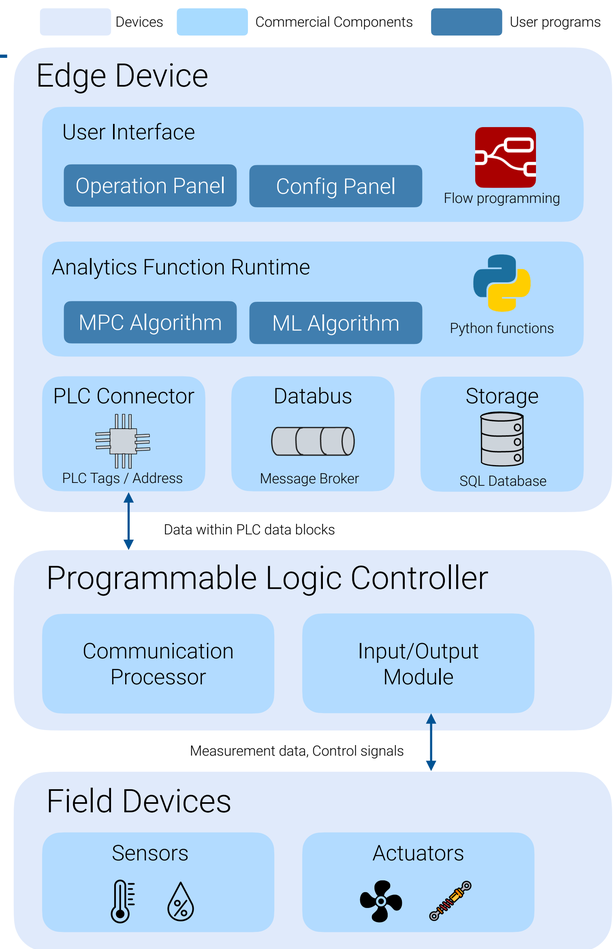
Execution of Python functions on an edge device is managed through a specialized analytics function platform.

User interaction is facilitated by a Web User Interface developed with a tool based on Node-red - IE Flow Creator.

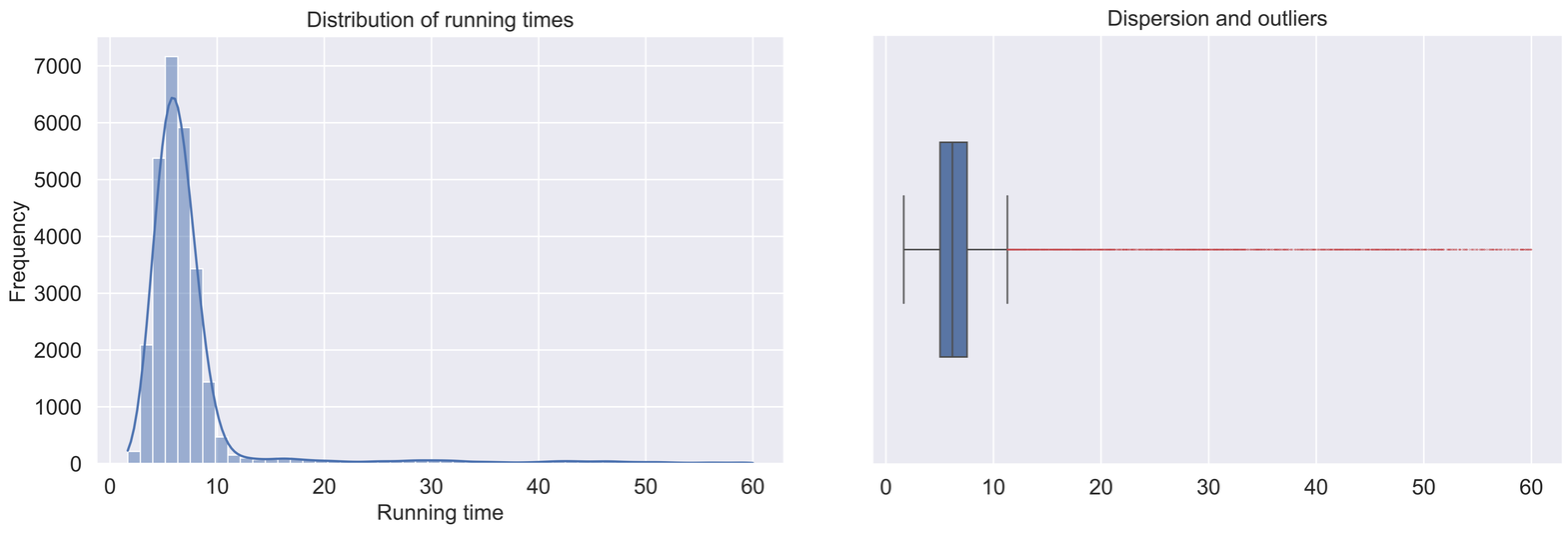
Specific performance requirements are critical to deploying MPC on edge for optimizing actual control processes:

Execution times must be sufficiently brief to ensure smooth, uninterrupted process operation.

Identifying and delegating problematic input sets to the operator or an alternative controller is vital.



Deployment setup for MPC on Edge



Exploratory analysis of running times of the MPC algorithm

Conclusion

The comparative analysis highlights Edge technology as a preferred choice for enhancing control systems by providing local intelligence, validated through deployments of advanced algorithms like MPC in large and complex environments like CERN.