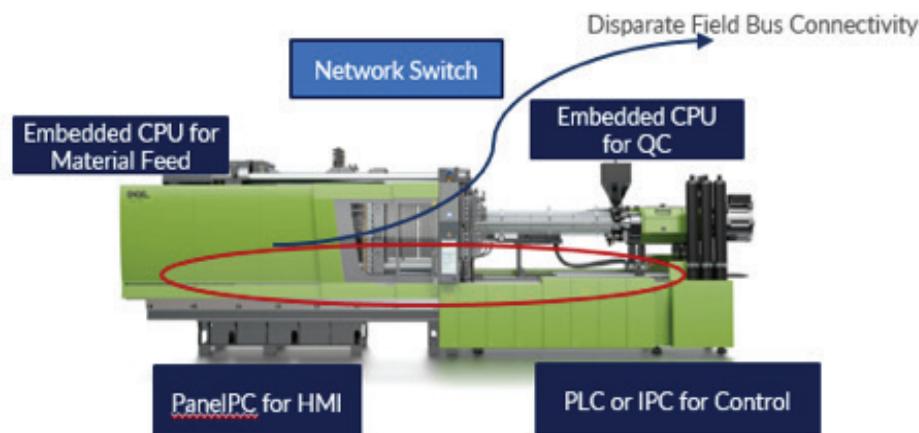


The Machine Ecosystem

A traditional machine consists of tens of controllers performing functions in a silo'ed manner. The sensors, actuators, and other field devices work together to create the main control loop of the machine. The Industry 4.0 initiative to standardize components and the availability of industrial PCs have driven the need for applying edge computing to the machines. Edge computers provide a platform to integrate some functions and a means to use analytics to influence the control loops. The Nebbiolo Platform Solution takes this one step further by applying the fog computing paradigm to the machine.

Customer Problem

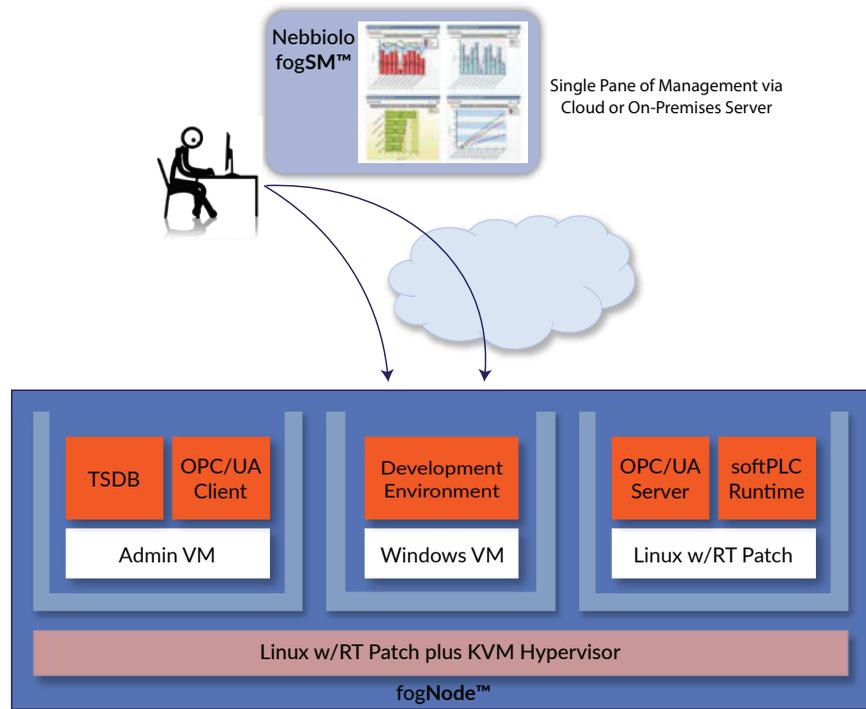
The complex interworking of all components needed for the machine to function necessitates a long configuration and tuning cycle when setting up or retooling the machine. Any data within the machine ecosystem that could be used for predictive maintenance and quality testing remains locked. A standards- based approach to connectivity with the machine by using protocols like OPC/UA and TSN necessitates new hardware and software infrastructure. At the same time, the investments made by machine builders and machine users in developing application software need to be preserved.



Nebbiolo Technologies' Solution

The Nebbiolo fogNode™ with its integrated hardware and software system that runs the fogOS™ and the fogSM™ offers a comprehensive solution for the management of the machine ecosystem. The Nebbiolo Platform combines machine control, device management, data gateway, application hosting and analytics functions to enable the following features:

- Integrates the functions of many controllers on a single virtualized platform. The machine builder need not worry about hardware obsolescence as their investment into software is protected.
- The integrated analytics platform provides a robust infrastructure needed to host advanced analytics applications like predictive maintenance and predictive quality.
- Nebbiolo's fogNode Real-time capabilities implemented on the finely tuned fogOS and advanced CPUs enable not only fast control loops but also real time acquisition and analysis of data.
- The application store in the fogSM provides the infrastructure to host applications and machine configuration in the cloud. Deployment of new machines and retooling of existing machines become much easier as all machine parameters for a given job are stored and applied at will.
- Asset management features in the fogSM enables remote management of multiple machines including secure and safe software upgrades.
- Nebbiolo's support for standards, such as OPC-UA, MQTT, etc, creates a data gateway, and a offers wide range of connectivity options.
- Data rights' management offers segregation of data streams between machine builder, end customers, system integrators, and service providers.



Benefits and Summary

- By delinking the hardware and software layers through using a virtualized infrastructure, Nebbiolo's fogOS and fogSM help to preserve the software investments. Legacy software can be deployed as Virtual Machines or Docker containers.
- Typically, the setting up and retooling of machines is one of the most time-consuming parts of a production flow. The Nebbiolo Technologies' solution, with its application and configuration stores, provides an easy way to replicate and reuse proven configuration settings and applications.
- The fogNode and fogOS provide the typical data gateway functionality that an edge computer provides and much more. By implementing data rights-management, the machine owner has full control over which data stream gets sent to which destination. This provides a means to unlock the dormant data from the machine and at the same time alleviates any concerns about data ownership.
- The real-time capabilities of the fogNode provide a platform to implement PLC functions. It also enables the acquisition and processing of real-time data from machines. Golden signature of machine axes and other devices can be stored and compared against acquired data to predict the quality of the parts being produced as well as the health of the machine.
- This Nebbiolo Technologies solution implements the fog computing paradigm with numerous benefits for machine builders and machine users. The Connected Machine use case realizes OPEX savings through the integration of functions and improved turn-around times by automating application software deployment.