nebbiolotechnologies™
fog computing pioneers

Industrial Floor Streaming Analytics USE CASE

Industrial Data Visibility, Analytics, and Ownership

One of the fundamental promises of Industry 4.0 is to make available to the Industrial Manufacturing Floor some of the advances in data management and analytics, including Machine Learning and Artificial Intelligence. The hope is that this new visibility and understanding will help improve production efficiency and product quality.

Early deployments focused on connecting and extracting data from Industrial machines/sensors with the help of Gateways which would route this data to points of aggregation and analysis in the Cloud. This early approach provided value but proved costly when, as the volume of data collected increased exponentially, it created management and security challenges.

Now, there is a clear understanding that data management, data cleaning, data securing, data analytics, and even data storage need to happen first on the Industrial Floor, as close as possible to the machines.

Ultimately, the traditional hierarchical organization of the Manufacturing Floor, defined by the Purdue model and by the Industrial Automation Pyramid, needs to map into a hierarchical data management and analytics functionality, going from the end points all the way to the Cloud.

Customer Problem

Customers and plant owners embarking on the process of extracting data from their machines and sensors first face the challenge of a lack of standardization in the connectivity protocols used by such non-homogeneous industrial end-points. These endpoints are built by many different machine and tool builders and speak different "languages," leading to a "Tower of Babel" problem.

While a standards-based approach to connectivity is progressing with the adoption of protocols like OPC/UA and TSN, this progress requires time and necessitates new hardware and software infrastructure. The investments made by machine builders and machine users in developing their current application software need to be preserved.

The next customer challenge is the proliferation of un-managed and weak gateways trying to connect individual machines to their specific machine builder Clouds. Customers need to aggregate larger amounts of data from a multitude of different machines, provide local data management, security, data reduction, and analytics over a common, distributed infrastructure.

Customers also want to retain control of their own data and do not want to be beholden to single vendors who may not have the customers' interests as their first priority.

Nebbiolo Technologies' Solution

The Nebbiolo Platform, with its distributed and federated fogNodes™ running the fogOS™ stack and its centralized (in Cloud or on-prem) fogSM™, offers the ideal infra-structure for the support of coordinated, hierarchical data management and analytics for the Industrial Floor, and supports the traditional Industrial Automation functional pyramid as shown in Figure 1.

Nebbiolo's data management and analytics functionality can be deployed even in the end devices and machines; but it is more naturally deployed at the shop/cell level, at the line/plant level, and at the data center/cloud level. The typical breakdown of functionality across the layers is highlighted in Figure 1.

Progressively, the data coming from sensors and machines in the Operational Technology (OT) network is compatible with the Open Platform Communications - Unified Architecture (OPC-UA) machine-to-machine communication protocol for industrial automation. However, Nebbiolo provides IoT connectors to handle data from devices that are not OPC-UA-compatible. This is made possible by the

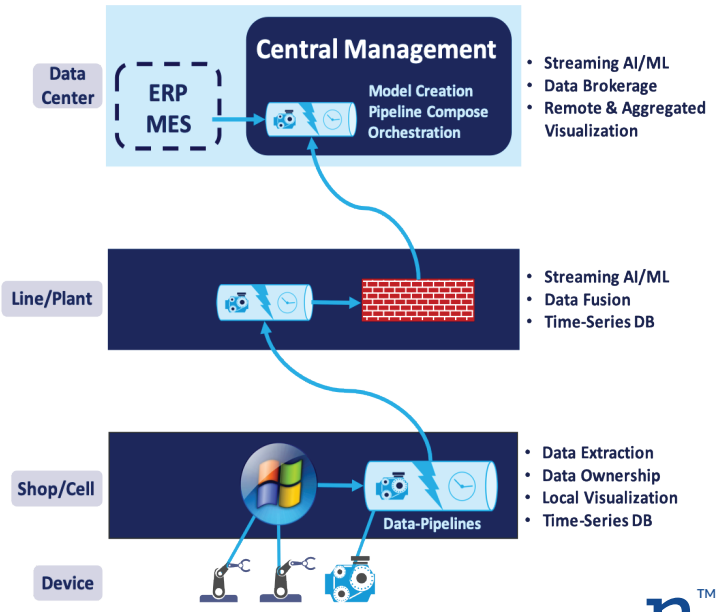

Figure 1

Nebbiolo Technologies' Solution (cont'd)

virtualized nature of Nebbiolo's fogOS, enabling the co-existence of Windows and Linux workloads on the same fogNodes. Note that many of the current solutions on the market for data extraction (e.g., from Matrikon, OSISoft, Kepware, etc.) require a Windows OS for their deployment. On the other hand, many of the advanced analytics and visualization packages are Linux based.

The Nebbiolo real time data streaming infrastructure provides a federation of Time Series Data Bases, interconnected by forwarding functions able to elaborate, fuse, and/or reduce the data at each stage. Each fogNode provides a graphical visualization of the local data, while the fogSM provides for the aggregated view, as shown in Figure 2.

Process engineers and data scientists find the ideal development environment that enables them to design complex algorithms by using the built-in, powerful, graphical tool and then to deploy these algorithms as containers on the appropriate fogNodes. Each operator can visualize the data as needed by his own role on the production plan.

The Datastream pipeline is designed to provide extract, transform, and load (ETL) functions and complex event processing (CEP) capabilities to address use cases requiring:

- Real-time statistical analysis on a data stream
- Detection of anomalies and notification of alerts
- Deployment and programless learning for Machine Learning/Artificial Intelligence (ML/AI) modules

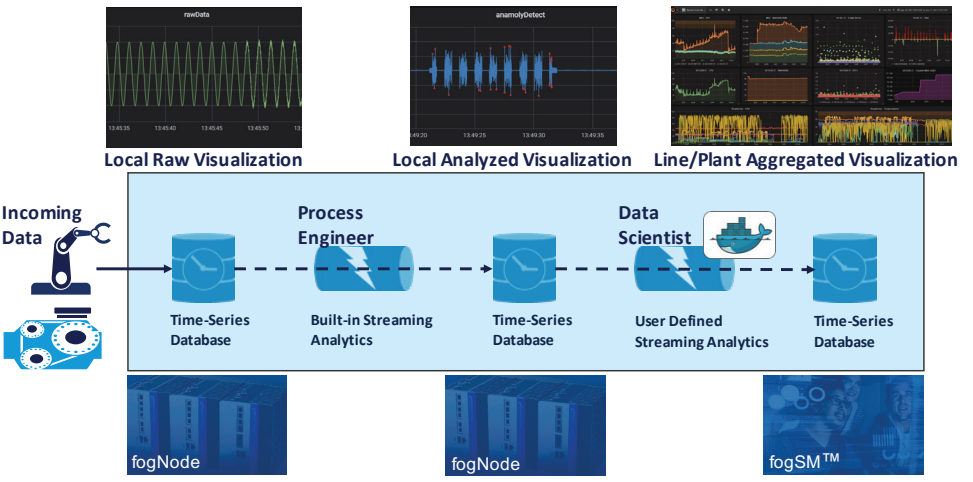

Figure 2

Benefits and Summary

It is of paramount importance to engage the people who have deep knowledge of the industrial process under analysis from the very beginning. By implementing data rights-management in fogOS, the machine owner has full control over which data stream gets sent to which destination.

By offering local data management and streaming analytics that may be graphically configured and managed, the Nebbiolo software Platform gives control exactly to the people who own and understand these production processes. This provides the means to unlock the dormant data from the machine and at the same time alleviates any concerns about data ownership across the plant.

The powerful benefits of a well-planned, hierarchical, data management and analytics deployment in Industrial plants can be summarized in the following points:

- Improved Productivity (Predictive Quality, Predictive Management, Utilization, Efficiency)
- Evolution from sampled quality inspection to inline 100% predictive detection of failures
- Continuous process improvement and learning cycle based on more granular visibility
- Deployment of an Open Framework, with the ability to progressively extend data science modules, without a lock in to single vendor
- Data Privacy with the support of stream separation and encryption
- Reduction of Cloud charges, by local data reduction, storage and analytics
- Control Improvement by using local sensor data and local real-time analytics

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