



# Fog Computing: Keystone of Industry 4.0

Introducing the First Fog Computing Platform  
for the Convergence of Information  
and Industrial Operations Technologies

## Industry 4.0 and Fog Computing: Improving Industrial Automation through the Convergence of Information and Operations Technologies



Industry 4.0 aims at improving efficiency, flexibility and security in Industrial Automation through the extensive adoption of advanced Information Technologies (IT) in the domain of Industrial Automation operations. A first fundamental element in Industry 4.0 is the application of Cloud technologies to the Industrial domain. Two additional key technological themes will contribute to the future of Industrial Automation, consistently with the goals of Industry 4.0:

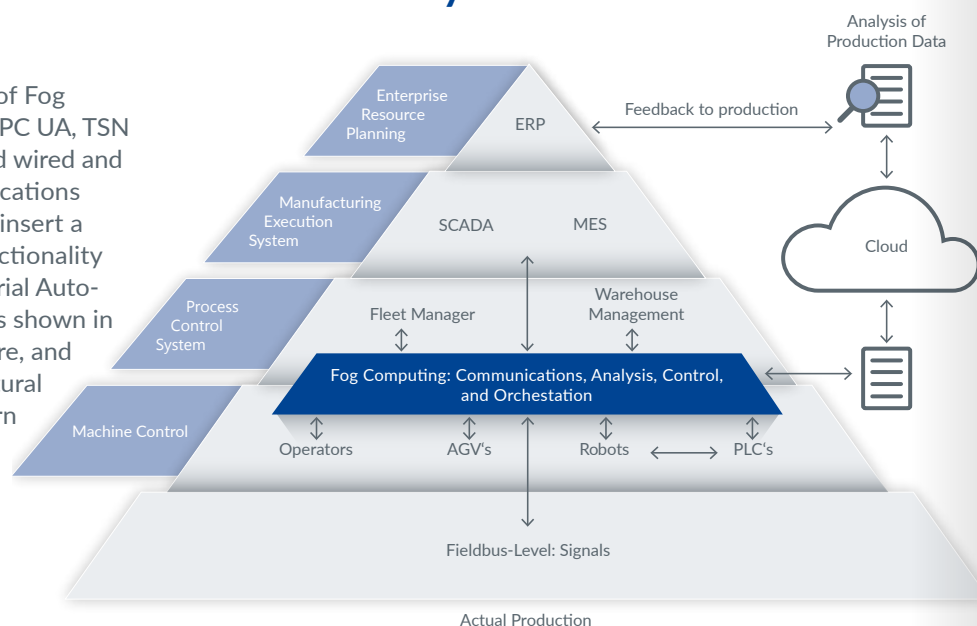
**Fog Computing**, also referred to as real-time Edge Computing, brings together, close to the industrial floor, many Cloud features, and real-time and safety features. It is an ideal bridge between modern Information Technology and

today's Operational Technologies. It enables scalable computing at the edge, resource virtualization, supporting both real-time and non real-time computing, modern application management and data interoperability middleware, including **OPC UA**, edge storage and analytics, advanced networking and security.

**Time-Triggered Technologies**, pioneered by TTTech, is based on precise time distribution and time-sensitive networking and computing resource allocation. It is being standardized as **IEEE Time Sensitive Networking (TSN)**. TSN enables the convergence of many of the current Industrial wired protocols towards a unified standard, is one of the key elements of Industry 4.0 and a necessary component of Fog Computing.

## Fog Computing: A New Functionality Layer in the Industrial Automation Pyramid

The combination of Fog Computing with OPC UA, TSN and other standard wired and wireless communications technologies, will insert a powerful new functionality layer in the Industrial Automation pyramid, as shown in the following Figure, and will enable the natural insertion of modern IT technologies.



## Nebbiolo Technologies: Introducing the First Fog Computing Platform for Industrial Automation

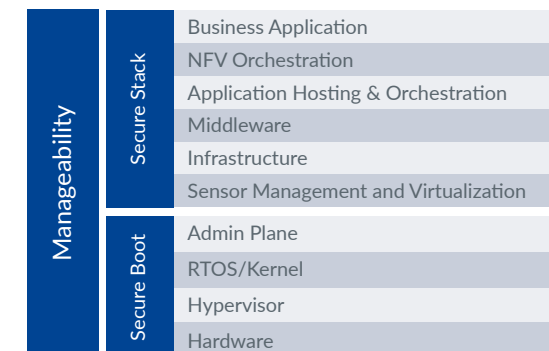
### 1 Hardware Architecture

A flexible, modular, reliable, high performance, highly connected, scalable, real-time capable hardware architecture, manifesting in a family of Fog Nodes.



### 2 Software Stack

A rich software stack on each CPU subsystem (FogOS), enabling fast, secure solution deployment.



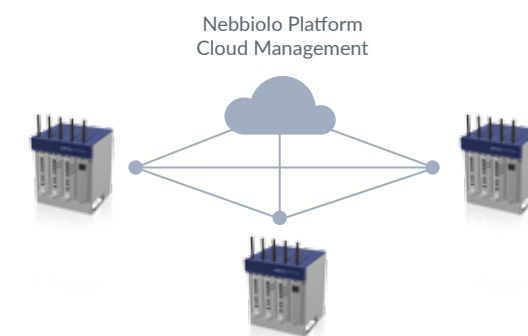
Software Stack (FogOS)

### 3 End-to-end management

An advanced end-to-end management of distributed networking and computing systems, assets, software and applications.



Endpoints on the Industrial Floor



A Federation of Distributed Fog Nodes

# Advantages of the New Fog Computing Based Industrial Automation Architecture

- Insertion of modern wired and wireless, and deterministic communications technologies
- Natural interplay between Cloud, Fog and machines on the Industrial floor
- Secure software management, with non service impacting upgrades
- Modern application deployment and management on the industrial floor
- Insertion of modern application aware and software defined networking
- Rich device management and support of new classes of sensors
- Convergence of key industrial floor functions, today hosted in different, poorly communicating subsystems and control points
- Real-time local decisions based on complex analytics



**This architecture will enable a powerful convergence, unification and standardization at the networking, security, data, computing, and control levels. It will lead to improved interoperability, security, more efficient and rich control, and higher manufacturing efficiency and flexibility.**

Nebbiolo Technologies Key Partners:

**KUKA** **TTEch**

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