nebbiolotechnologies

fog computing pioneers

Fog Computing: Keystone of Industry 4.0 and Relevant to Innovation in the Textile Industry

Flavio Bonomi, CEO and Co-Founder, Nebbiolo Technologies
Andrea Robbiani, Italy Country Manager
Biella, June 29th, 2017

Agenda

- Fog Computing: Introduction
- Nebbiolo Technologies: Brief Introduction and Product Offering
- Applications and Relevance to thd Textile Industry Innovation
- Conclusions

The Pendulum Swinging Back: A Renewed Focus on the Edge of the Network, Motivated by the Network Evolution, 5G and IoT

Fog Computing

Also described as:

- **Mobile Edge Computing**
- **(Modern, Real-Time Capable) Edge Computing**
- **Real-Time Edge Cloud**

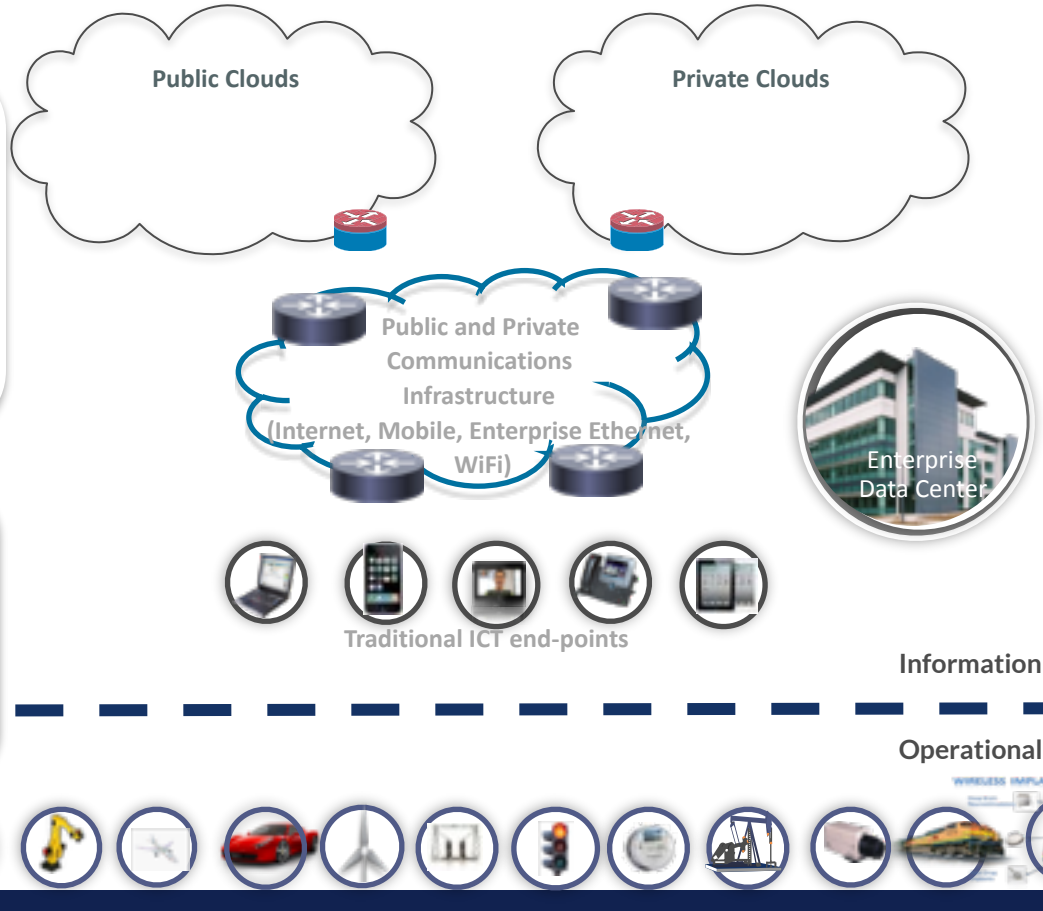
The Internet of Things: Information Technologies “Meet” Operational Technologies

Information Technologies Today:

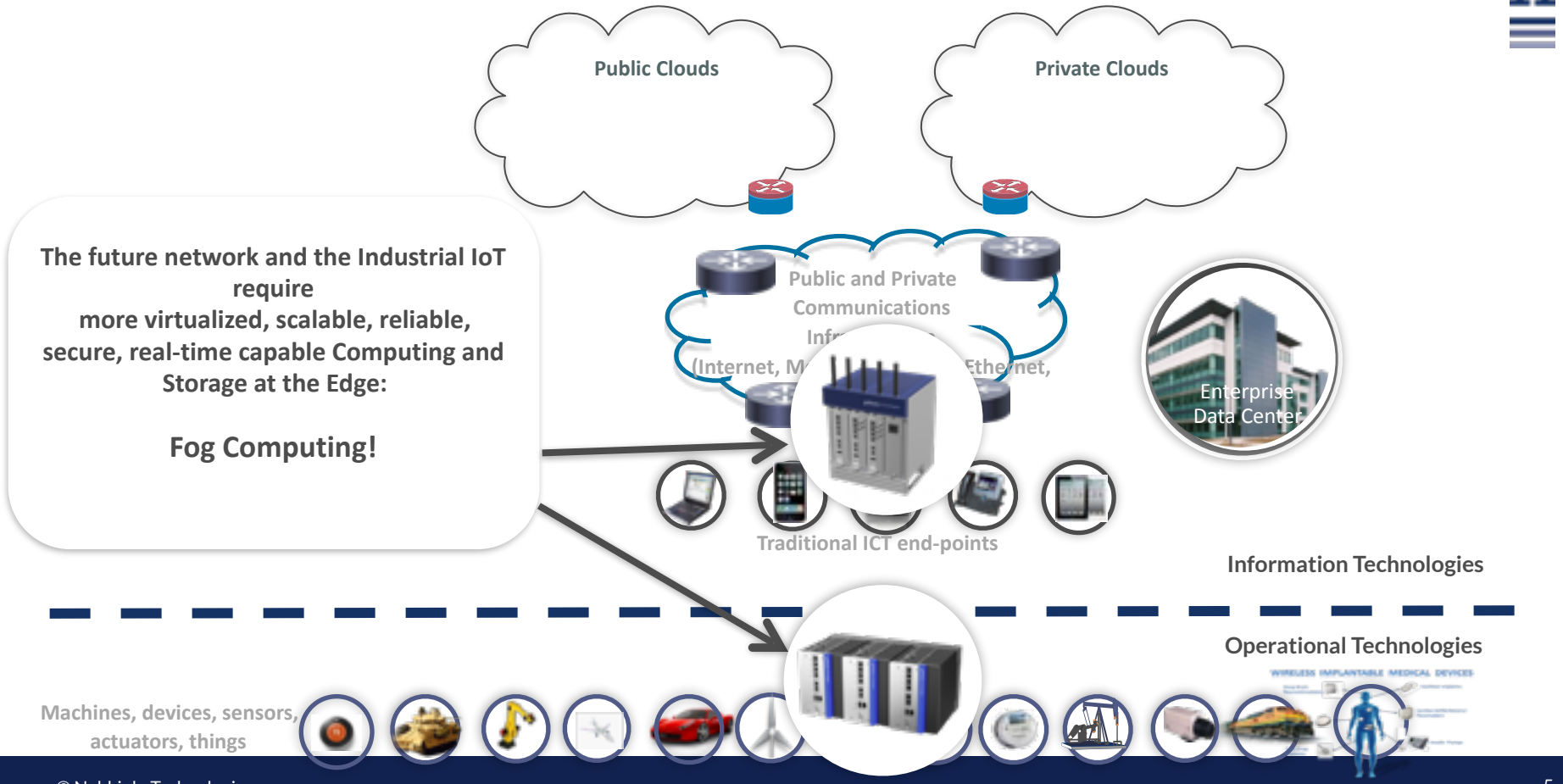
1. Clouds
2. Enterprise Datacenters
3. Traditional and Embedded Endpoints
4. Networking

The Internet of Things Brings Together Information Domain and Operations Domain through:

1. Connectivity
2. Data Sharing and Analysis
3. Technology Convergence



Industrial IoT, or Industry 4.0 Both Require More Distributed Computing



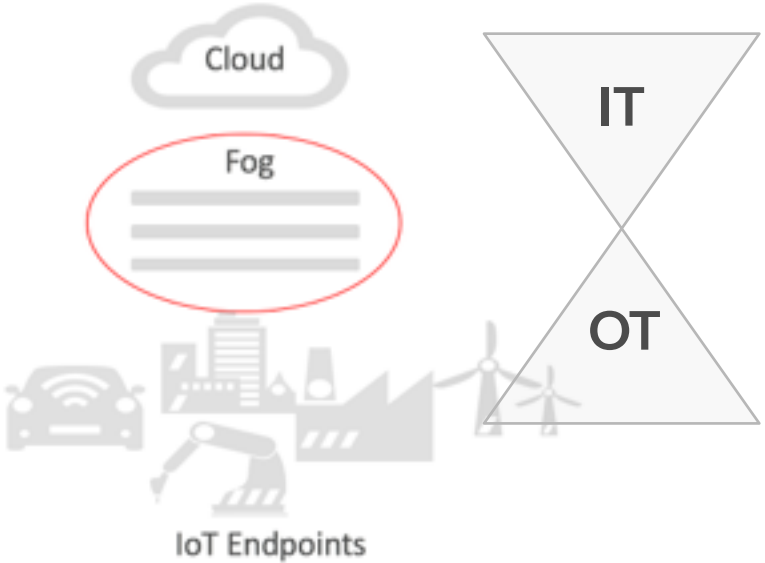
What is Fog Computing ?

The missing link between Clouds and Endpoints

Fog Computing brings:

Cloud-inspired computing, storage, and networking functions closer to the data-producing sources

while integrating real-time and safety capabilities required in the OT domain



Fog Computing is the key enabler of a real **convergence** between IT and OT technology

OpenFog

Peter Levine on Dec '16:
"Cloud computing is dead, the intelligence is going down close to the things"

A Few Key Architectural Angles Charaterizing the “Fog“ :

IT to OT Convergence
Hierarchical Data Management and Analytics
Virtualized and Distributed Application Platform
The Convergence of Control

Fog Computing Vision: Enabling the Convergence of IT and OT Computing and Communications Technologies at the Edge

IoT Gateway

Industrial PC

Industrial Micro controller PLC

Real-time capable, highly available, scalable, safe, trusted, Industrial

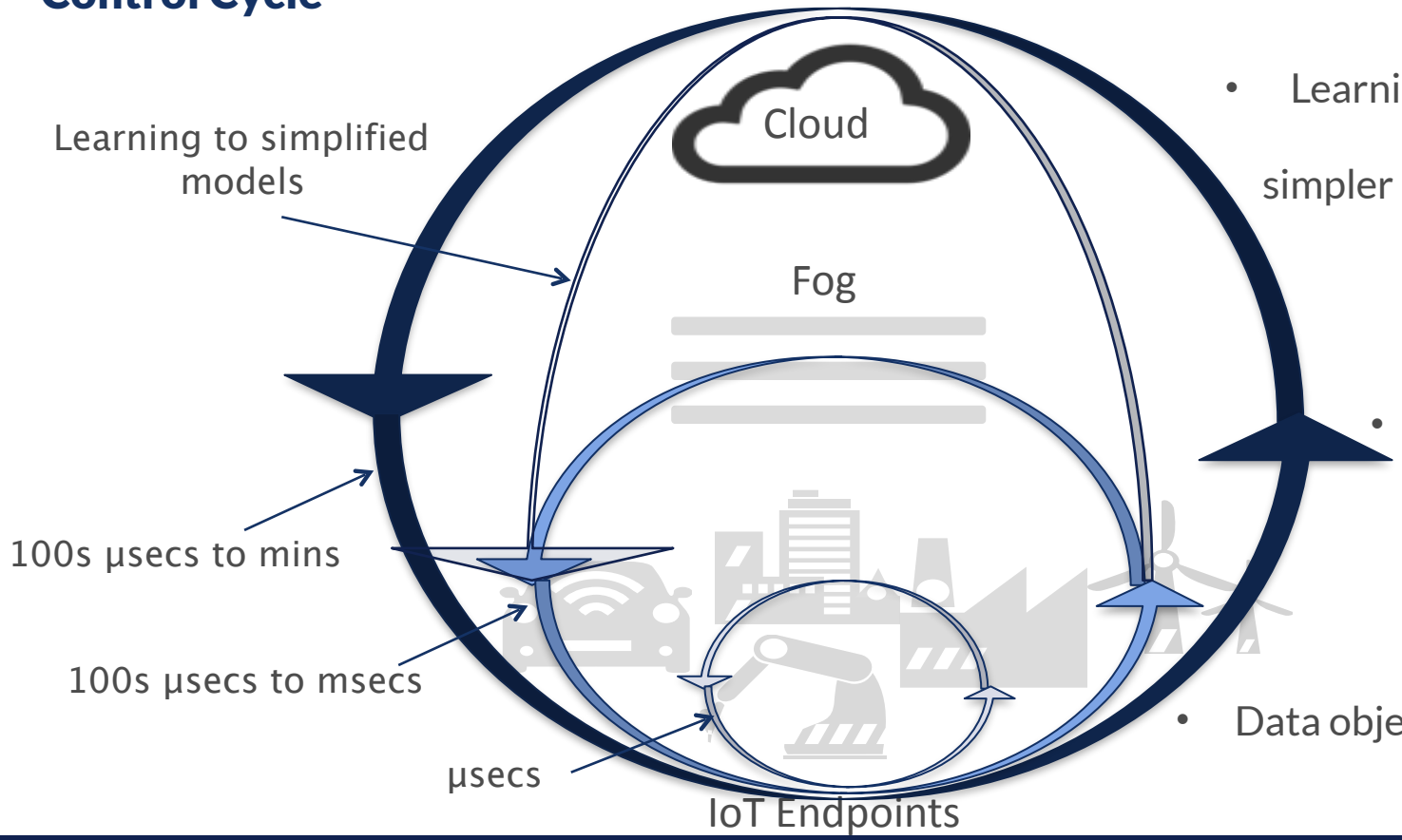
Fog Computing Nodes

Enabling the virtualization and consolidation of multiple, traditional Industrial Computers and Network Nodes

Data Center Servers or Micro-Servers

Industrial Switches, Routers and Firewalls

Fog Computing Vision: Supporting a Hierarchical Data Acquisition-Analysis-Control Cycle

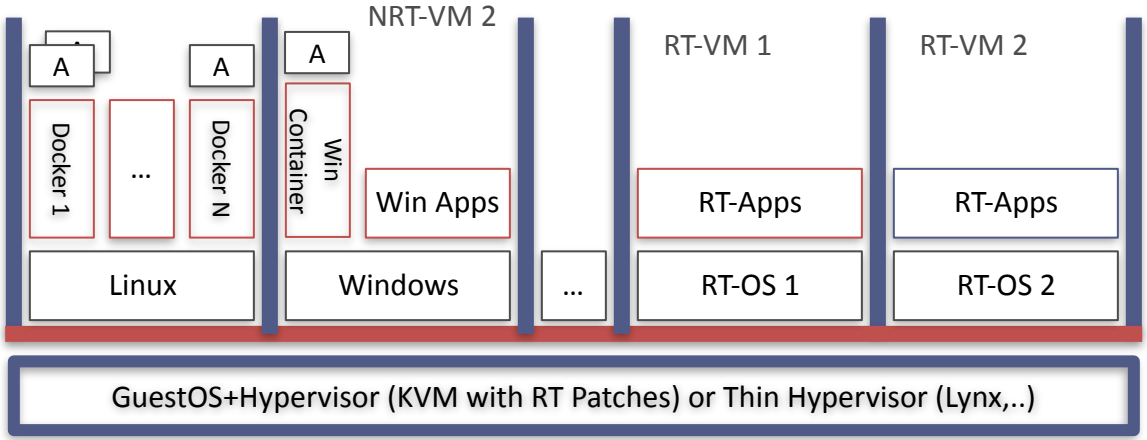


- Learning in the Cloud and deploying simpler models in the Fog
- Fast reaction to rich local analysis
- Data objectization and reduction

Fog Computing Vision: Real-time Capable Virtualization to the Edge

Virtualization:

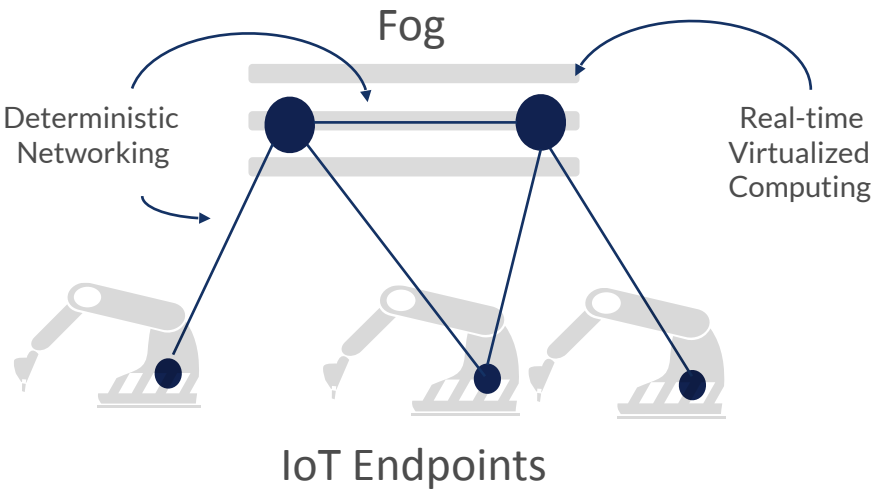
A combination of physical separation (multicore), hard, RT-NRT Virtual Board/Machine based virtualization and more lightweight Linux/Windows Container or Docker based virtualization

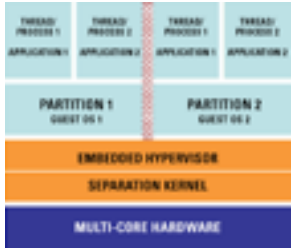


Fog Computing Vision: Enabling the Convergence of Control

Deterministic Networking and Real-time Virtualized Computing enable the Convergence of Multiple Control Functions, one step removed from the controlled Endpoints:

The Software Defined Machines! **(Ref: GE)**





Brief Introduction to Nebbiolo Technologies

Nebbiolo = Grape Enjoying the Morning Fog (=Nebbia) in Northern Italy

Producing wonderful wines: Barolo, Barbaresco,
Nebbiolo, Valtellina Reds

nebbiolotechnologies

pioneers of fog computing

Nebbiolo Technologies

Nebbiolo Technologies is architecting and building an innovative Fog Computing Platform for IoT Solutions

and applying it, first, in the vertical of Industrial Automation

Cisco sourced, experienced (20+ people) team surrounded by a rich ecosystem of IoT te rs

Investors: KUKA Robotics, TTTech and GiTV (Tokyo, Japan VC)

Milestones: 7 Patents pending; Strong Traction; Production deployments and PoCs ongoing;
First product released (December 2016)

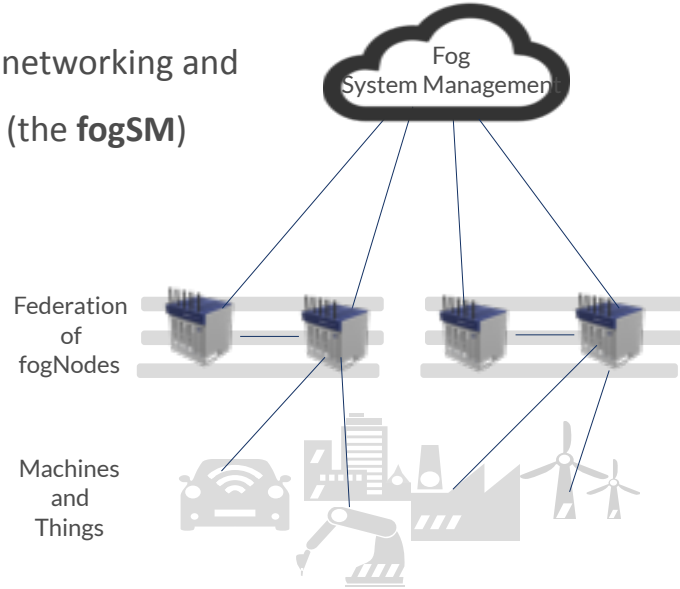
Nebbiolo Technologies Fog Computing Platform Components

1. A **flexible hardware architecture** manifesting in a family of **fogNodes**

2. A rich **software distributed stack** (the **fogOS**), enabling fast, secure, flexible communications, data management and application deployment

3. An **end-to-end system management** of distributed networking and computing systems, assets, software and applications (the **fogSM**)

Manageability	Secure Stack	Business Application
		IoT Infrastructure
		Application hosting & Orchestration
		Midddleware
		Cloud Infrastructure
	Secure boot	Fog Infrastructure
		Admin Plane
		RTOS/Kernel
		Host OS/Hypervisor
		Hardware (X86/Arm)



A Groundbreaking Partnership

TTTech and Nebbiolo Technologies are working together to achieve **real-time capable**, **scalable** and **secure** Fog Computing solutions

nebbiolotechnologies
fog computing pioneers

- **Fog Computing** real-time capable architecture
- Fog **software infrastructure**
- **Cloud infrastructure** for end points management
- **Powerful and scalable** hardware

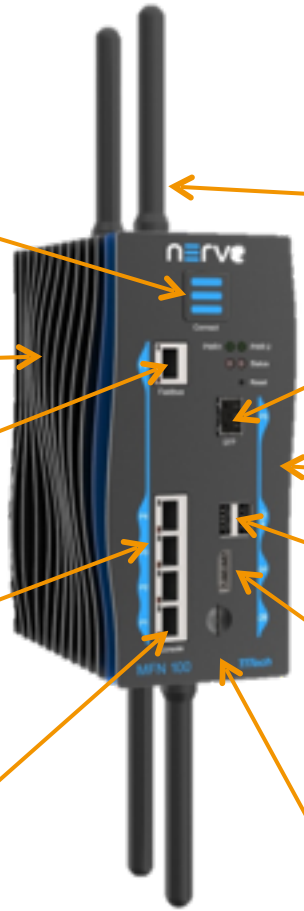
TTTech

- **Real-time & safe control** technology and expertise
- **OPC UA over TSN** (Time Sensitive Networking) technology and expertise
- Dedicated **machine-level** hardware

nebbiolotechnologies
fog computing pioneers

TTTech

Machine Fog Node



"Connect" button enables user control over when data can be sent and gives clear indication of connectivity

Fanless cooling for operating temperature -40 °C to +70 °C

Fieldbus interface (PROFINET, other protocols on request)

3 x 100/1000 Mbit/s with TSN switching RJ45

1 x 100/1000Mbit Ethernet Console Port RJ45

IEEE 802.11 b/gn (2.4GHz) WLAN

1 x 1000 Mbit/s SFP

Intel Atom x5-E3940

2 x USB 2.0

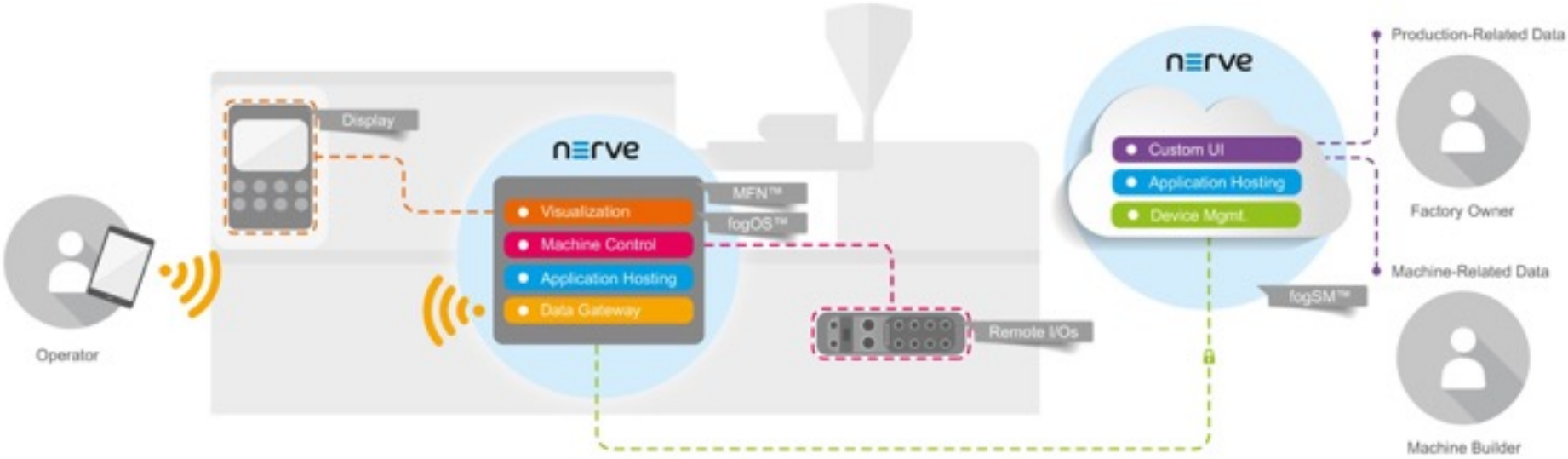
1 x Display Port

32GB SSD MLC (up to 128GB)
4GB Ram

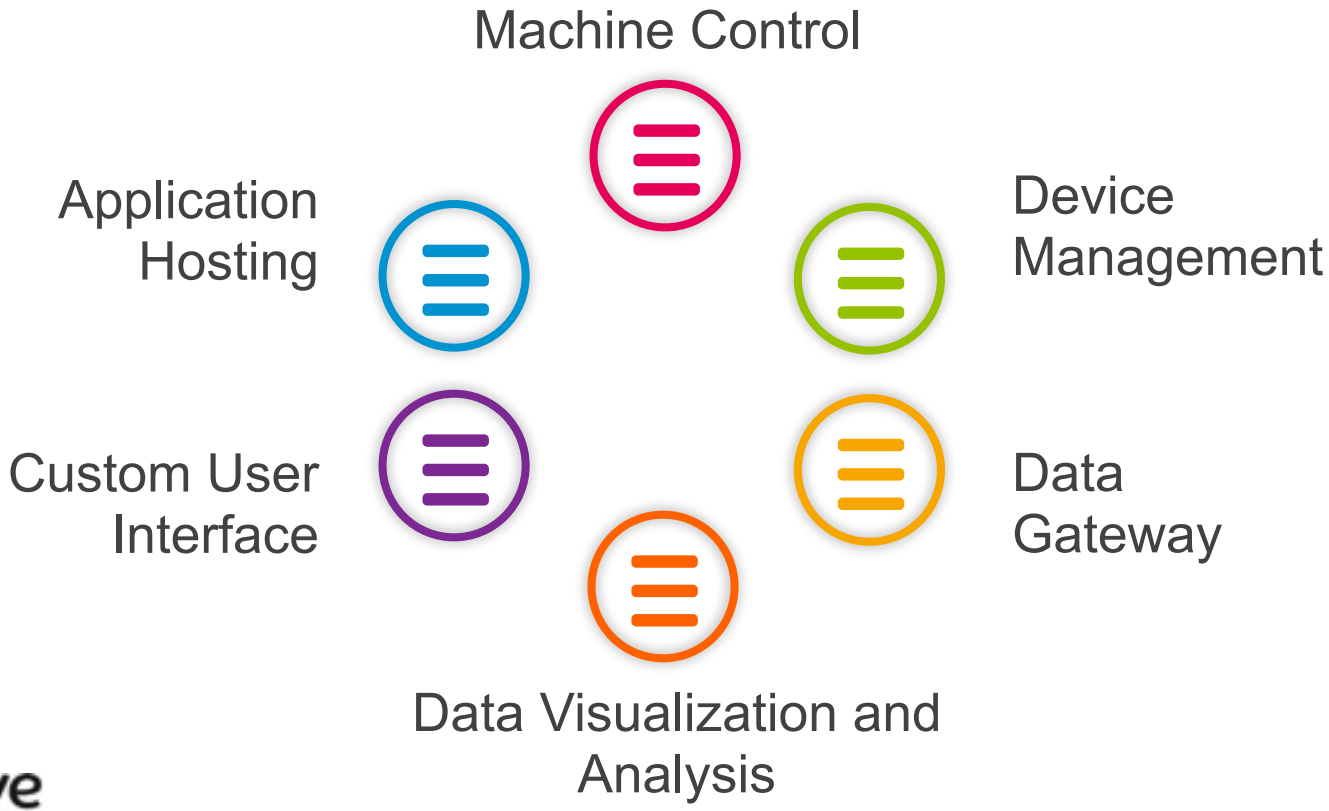
nerve

What is a Machine Fog Node?

A Machine Fog Node is used for controlling, connecting and remotely managing industrial machines.



Machine Fog Node Features



Fog Computing and 5G, Natural Partners for the Future of Key Industrial IoT Verticals:

- Industrial Automation
- Automotive and Intelligent Transportation
- Smart Grid

Motivations: Licensed spectrum, reliability, range of features, investment, ….

Industrial Automation

Starting from Automotive Body Shops and Precision Machine Floors

The Situation:

The Industrial Verticals, with their Many Challenges, is Facing an Epochal Transition

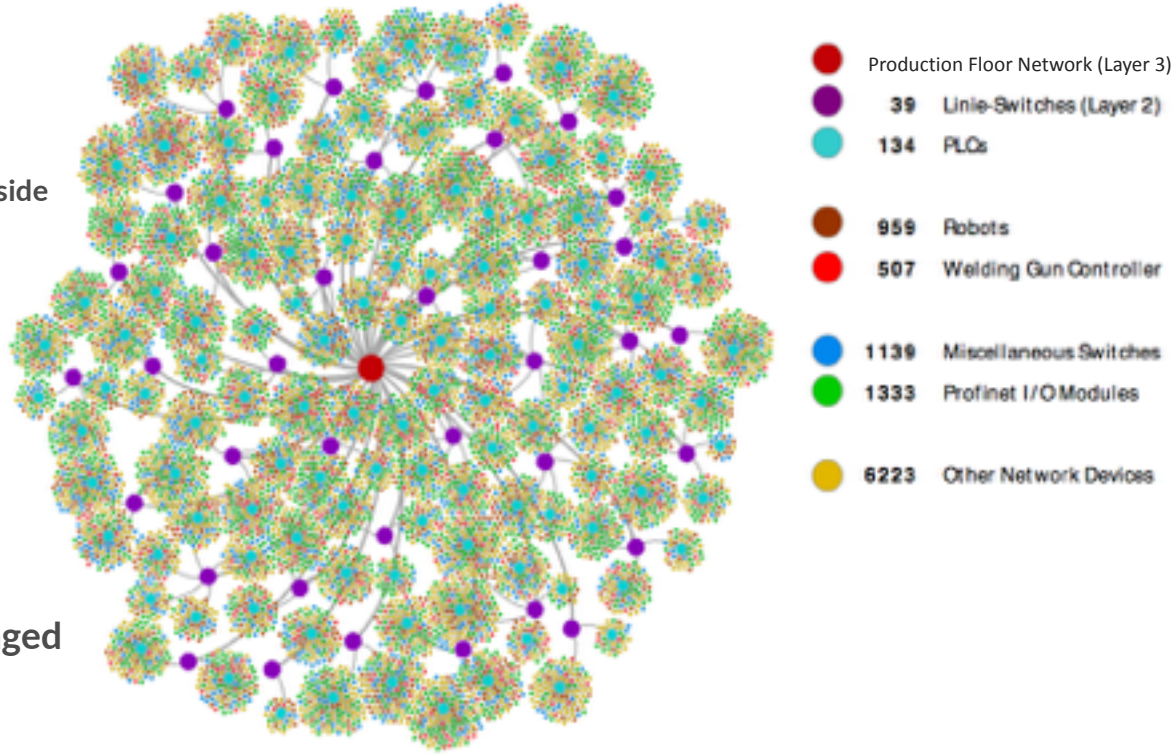
Typical Challenges for Industrial Operations Technologies Space Today

Fragmented, Poorly Managed, Unconnected Computational Resources

Example: Actual Automotive 'Body Shop' Network Devices Graph

Lots of Edge Computing, but:

- Dedicated
- Isolated, not connected to the IT side
- Not secured
- Manually managed
- Non-homogeneous software
- Not flexible
- Not open
- Not easy to host innovations



10s of Thousands of poorly connected, poorly secured and manually managed computers!!!

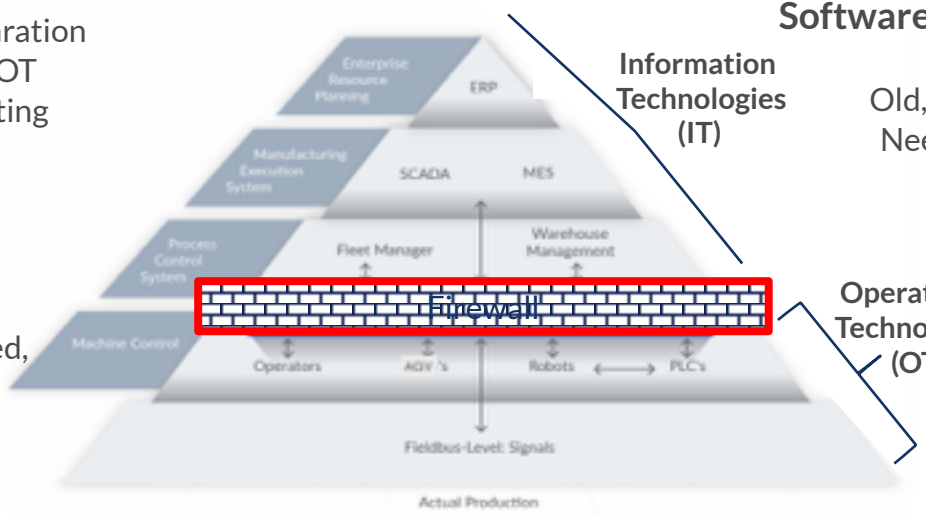
Industrial Automation Technology Challenges Today

Typical of Most Industrial Operations Domains

Data Analytics: Limited data acquisition, analytics and visualization at the edge

Security: IT and OT separation and lack of security in OT
Strict separation is limiting

Software: Different programming models across layers.
Old, insecure manual updates.
Need for modern application deployment



Information Technologies (IT)

Operational Technologies (OT)

Networking: Manually configured, non-standard technologies.
Limited wireless.
Hard to communicate across Firewall

Control: Fragmented, silo-ed, hard to program.
Need for sophisticated and collaborative, sensor rich control

Hardware: Fragmented.
Lack of convergent modular, scalable, flexible, trusted architecture

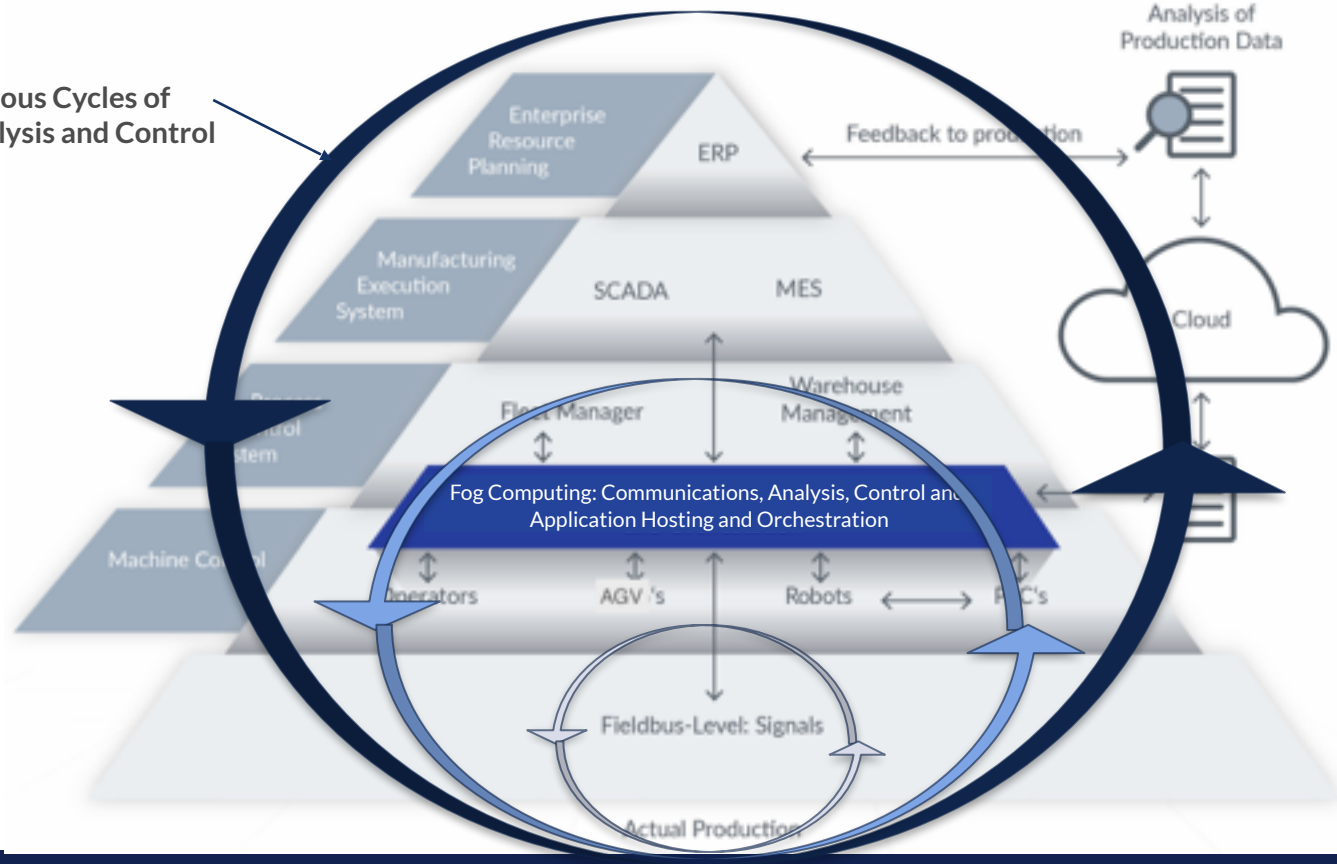
Nebbiolo Technologies Visionary Answer:

A Fog Computing Platform for the Future of Industrial Automation, and Other Verticals

Fog Computing: A New Functional Layer in the Industrial Pyramid

Driving **IT to OT Convergence** & the **Future of Control** for Industrial IoT and Industry 4.0

Hierarchical, Virtuous Cycles of Data Acquisition, Analysis and Control

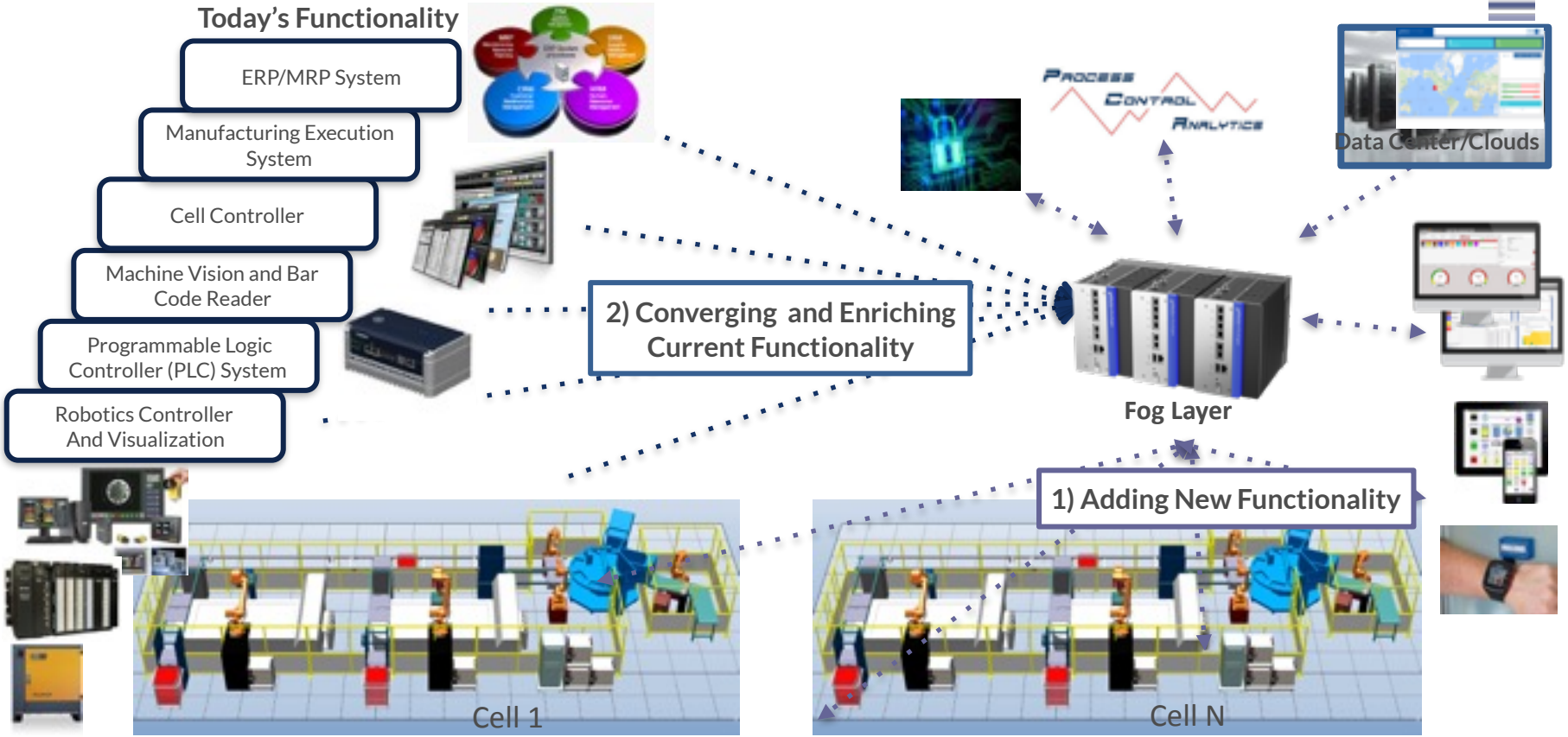


Cloud level optimization

Local, orchestrated control based on rich local analysis

Fast, Light Endpoint Control

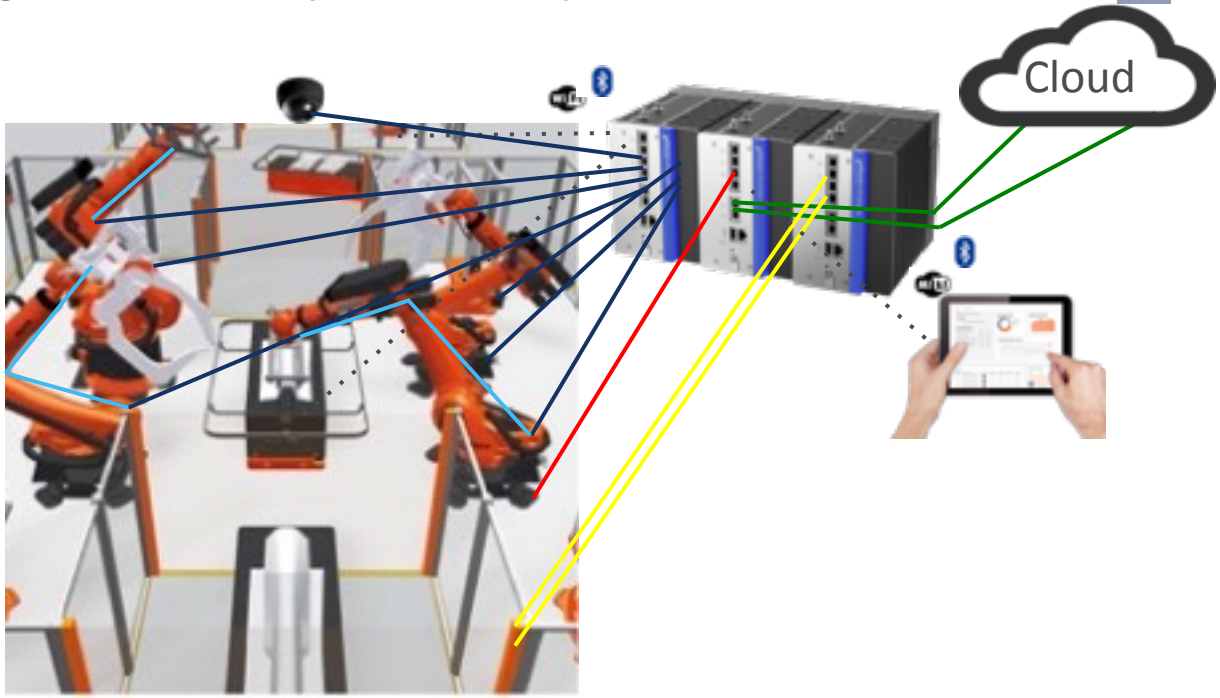
Fog-Based Industrial Floor: Enabling New and Converged Functionality



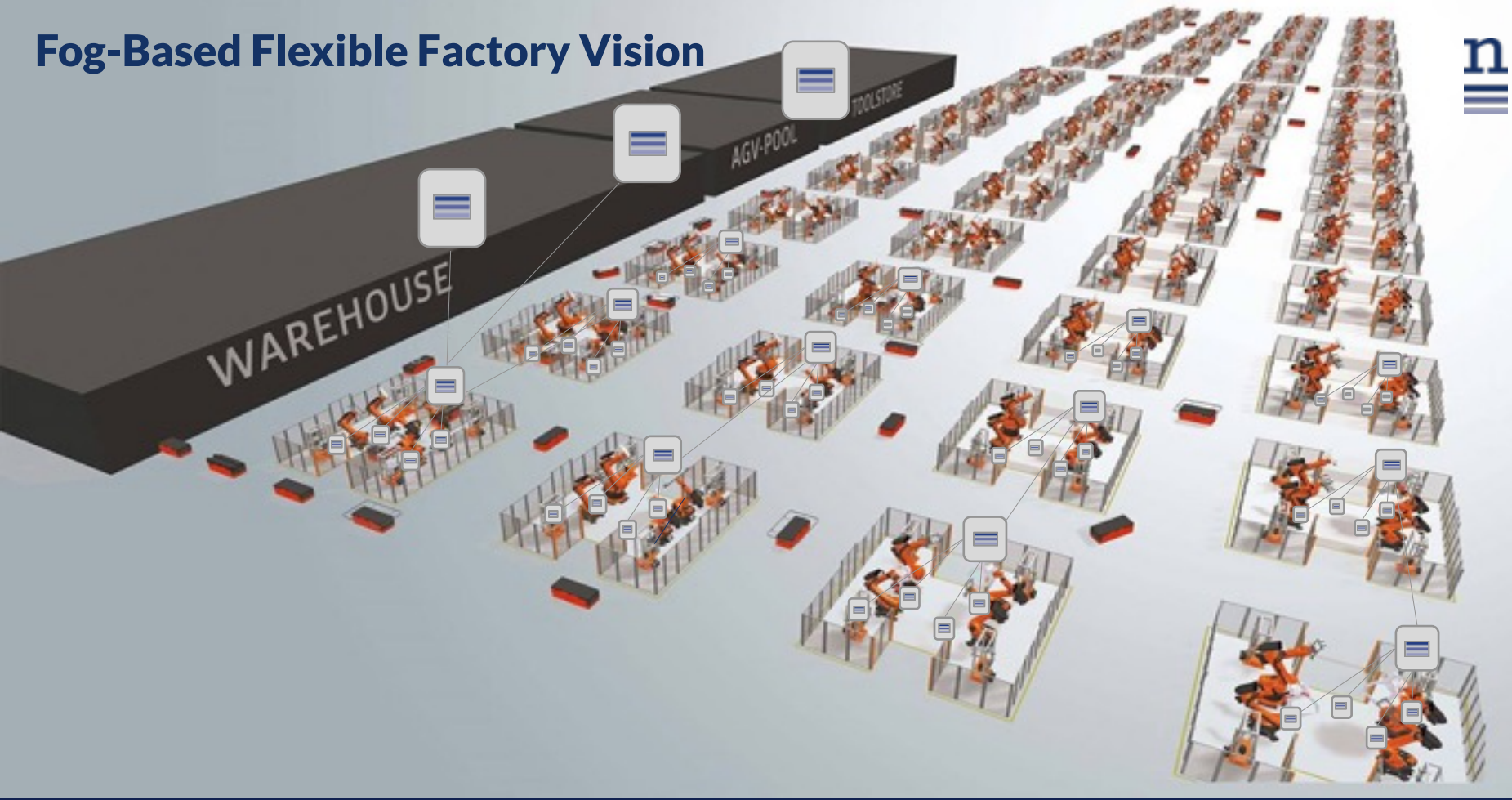
Fog Computing Based Future Manufacturing Cell Architecture:

Connectivity – OT and IT Convergence – Data Acquisition, Analysis and Control

- Legacy Bus or Ethernet based Industrial
- Ethernet with TSN
- Wireless: WiFi, BTLE, Wireless Sensor
- Ethernet with Optional TSN
- Safety I/O (e.g., Ethernet, other)
- Tool Connections (e.g., Ethernet, EtherCat, Can, etc.)



Fog-Based Flexible Factory Vision



Industrial Automation: Textile Industry Precision Machines

The Evolution of the Textile Industry Machines Many Open the Path to Innovation!

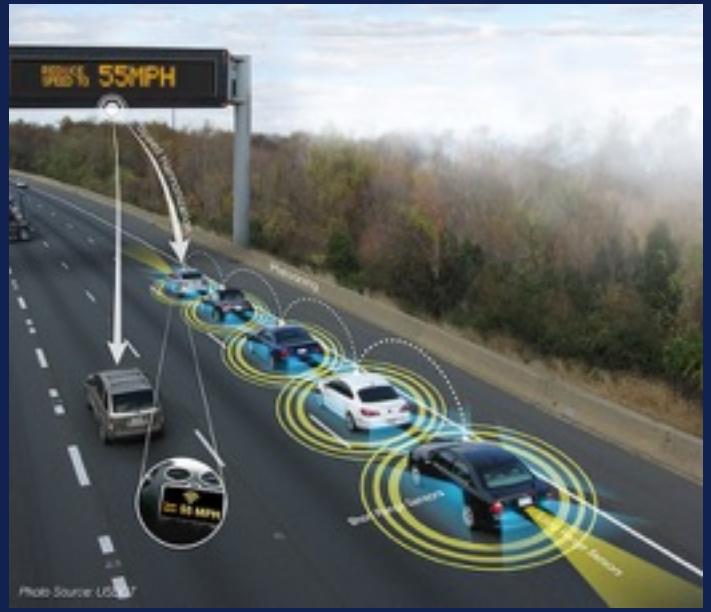
Industrial Machine: A Complex System with Many Sensors, Actuators and Control Loops

Fog-Based Industrial Machine: Enabling New and Converged Functionality

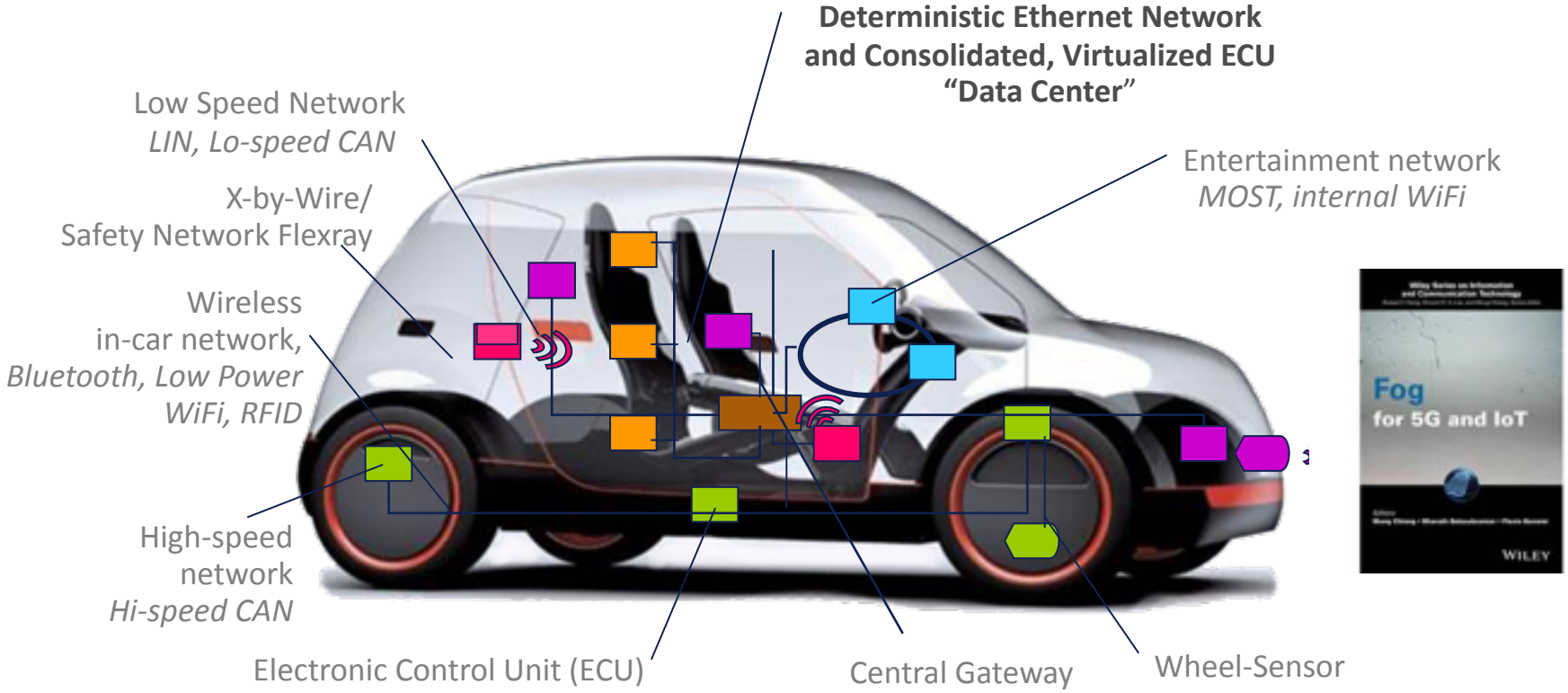
Fog-Based Industrial Automation: Value Proposition

- **Improved Uptime, Flexibility, Quality and Security**
  - Synchronized software updates without downtime
  - High availability via agile updates & redundancy
    - A 1% increase in availability for their upstream business, nets $300M to the bottom line (Ref: Shell)
- **Operations Efficiency and Cost Reduction**
  - Continuous condition monitoring with data analysis for improved visibility & optimized operations
    - 1% increase in efficiency, results in a savings of $300B in next 15 years **(Ref: GE)**
  - Virtualized converged infrastructure and centralized management of assets, hardware and software dramatically reduces operations costs
- **Improved Cell Cycles Time and Richer, More Orchestrated Industrial Controls**
  - A 5% decrease in cycle time @ auto body assembly plant could result in $10's of millions in additional revenues
  - Faster cell bring-up
  - Faster, richer control loops, via sensor fusion and local analytics
- **A Path to Innovation in Industrial Automation**

Automotive and Intelligent Transportation



The Role of Fog Computing in the Automobile Evolution



The Role of Fog Computing in the Automobile Evolution

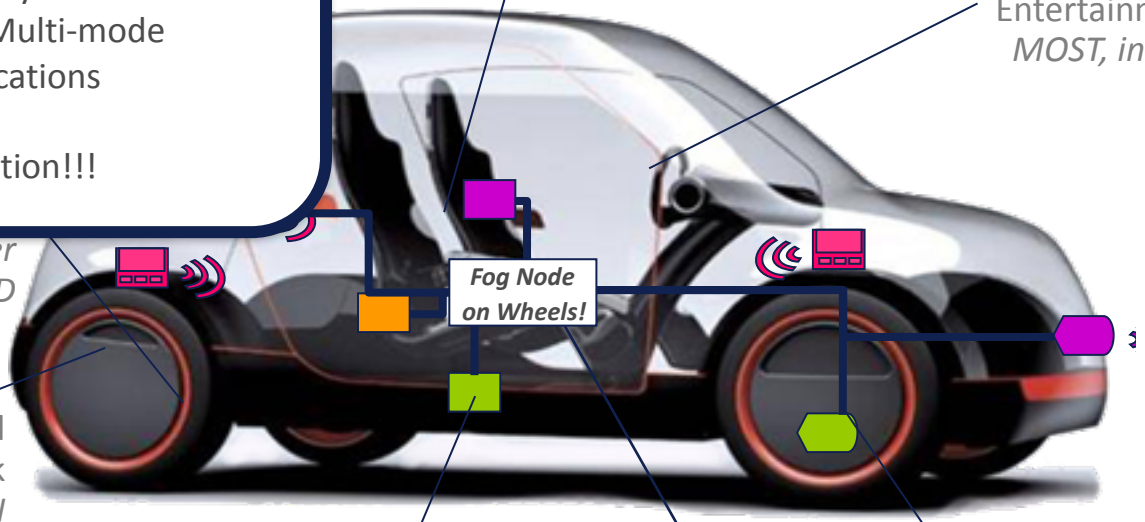
Key Directions:

Internal Networking Convergence
Computing Virtualization
Security
Mobility and Multi-mode Communications

Centralization!!!

Deterministic Ethernet Network and Consolidated, Virtualized ECU "Data Center"

Entertainment network
MOST, internal WiFi



Bluetooth, Low Power WiFi, RFID

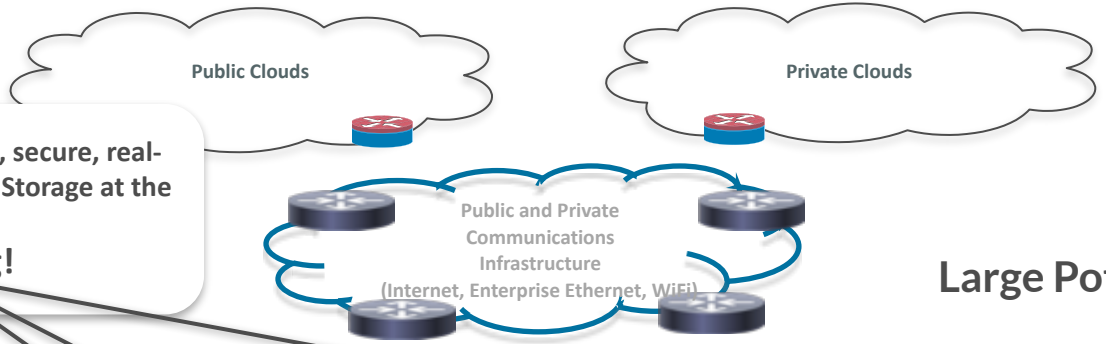
High-speed network
Hi-speed CAN

Electronic Control Unit (ECU)

Central Gateway

Wheel-Sensor

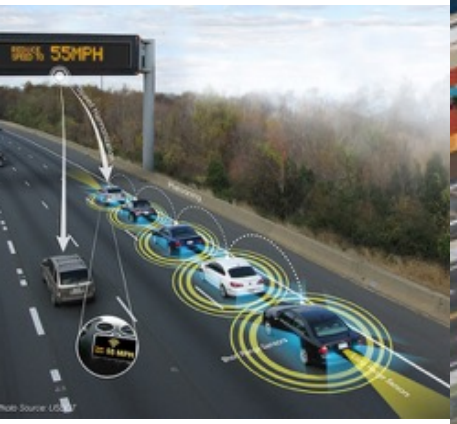
The IoT Infrastructure, Fog Computing and Intelligent Transportation

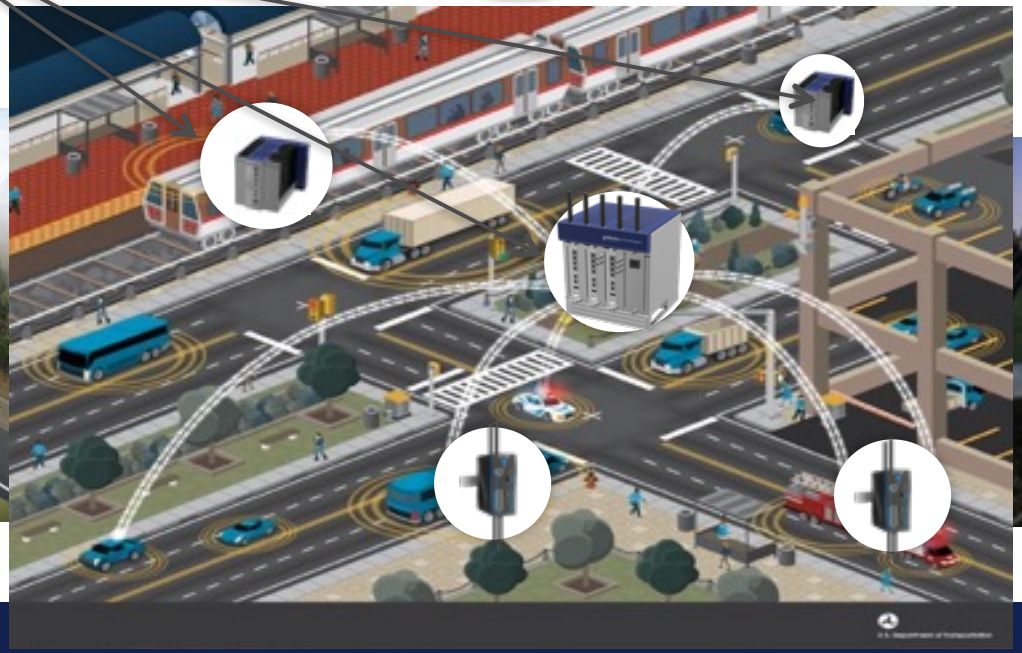


Virtualized, scalable, reliable, secure, real-time capable Computing and Storage at the Edge:

Fog Computing!

Large Potential Role for 5G!





Conclusions

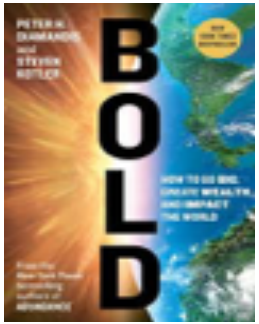
Conclusions

Fog Computing is a Keystone for the Future of Industrial IoT

The Deeper Convergence of IT and OT Technologies, Enabled by Fog Computing, Has Great Potential

More Collaboration and Experimentation is Required!

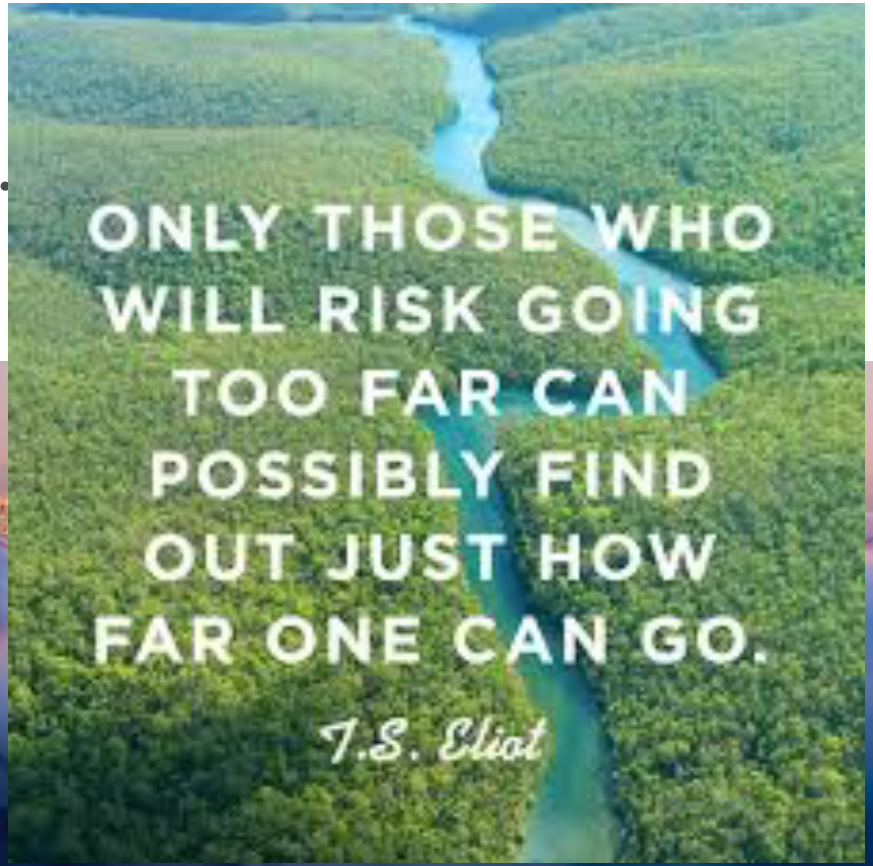
Let us Move Boldly, Together: The Future is Bright!



nebbiolotechnologies

fog computing pioneers

THANK YOU, AND REMEMBER ….



Nebbiolo Technologies, Inc.
860 Hillview Court, Suite 310
Milpitas, CA 95035
P +1 (408) 770-2828