

The Future of Boundless Automation

October 24, 2022



Agenda

| | |
|---------------|-----------------------|
| Peter Zornio | Boundless Automation |
| Laura Schafer | The Intelligent Field |
| Peter Zornio | The Cloud |
| Claudio Fayad | The Edge |
| Peter Zornio | Summary and Q&A |

Automation Inflection Points Move Industry Forward

Intelligent Sensors



HART
COMMUNICATION PROTOCOL



COTS* Equipment



DELTA V



Distributed Field



Future

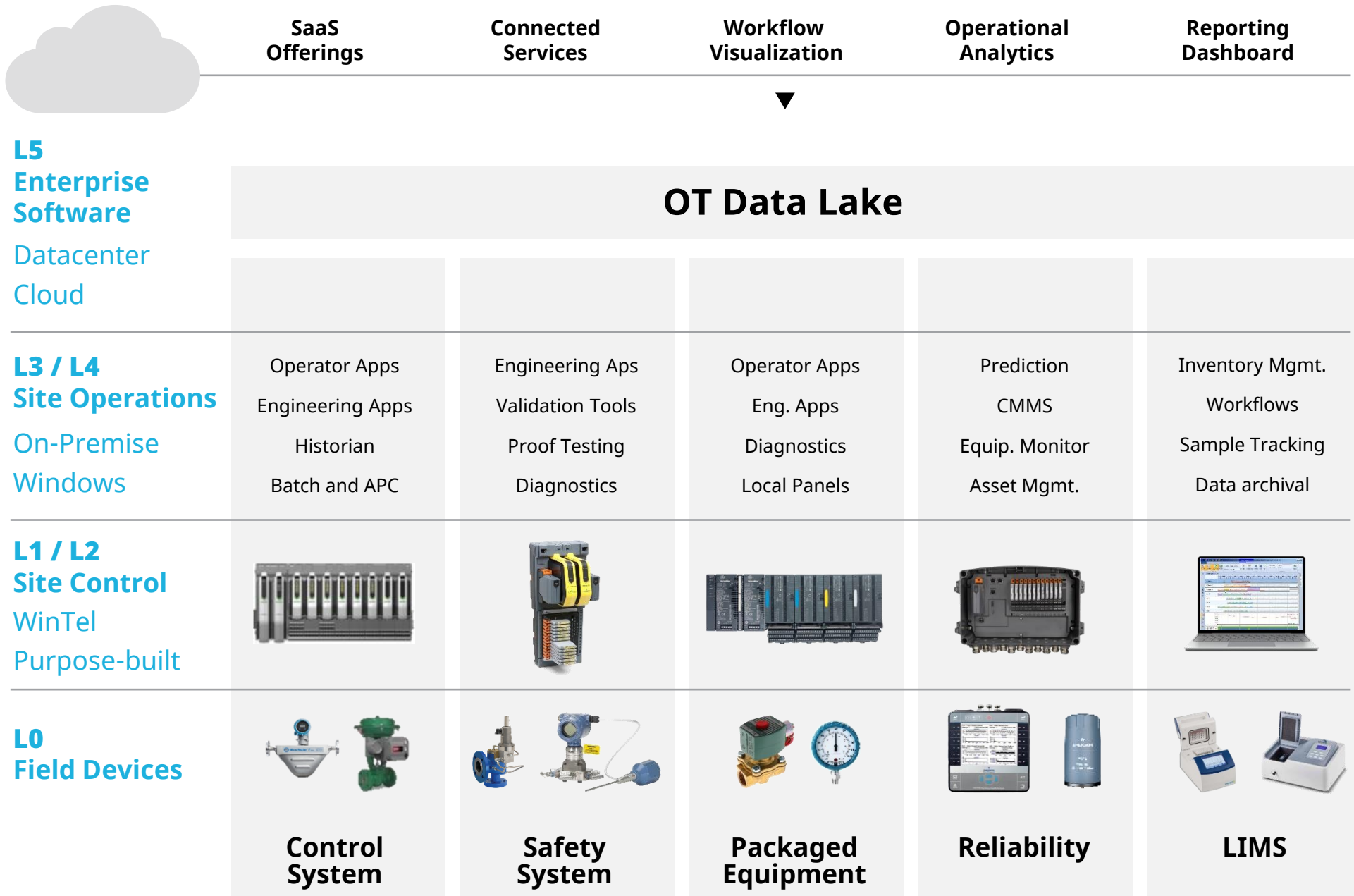


Boundless
Automation

30+ Years

* COTS = Commercial Off The Shelf

Today's Automation is Vertically and Horizontally Siloed Creating Pockets of Data and Expertise



PURPOSE BUILT AUTOMATION

Hierarchical automation networks

- Hard segmentation between OT/IT
- “Here’s your data – now go away”
- Complex security constructs between the layers – “in-depth”
- Hardware products designed for specific “layers” with associated software

A “one-way” architecture

- Data flow from bottom to top

Purpose built for automation applications

- Reliability, safety, energy – separate silos

Since its inception, automation has followed the “Purdue Model” – captured in ANSI/ISA-95

Market Needs Have Created an Inflection Point and Demand for a New Automation Paradigm

Market Needs



Digital Transformation



IT / OT Convergence



Data Democratization



Remote & Autonomous Operations



Asset Optimization



Sustainability

Modern Technologies



Cloud



Edge



AI / ML



Computer Vision



Wireless / Cellular



Virtual Reality

New Automation Paradigm

Software-Defined

Extensible

Enterprise-Wide

Data Centric

IT Friendly

Visualization Anywhere

Secure by Design

Simplified Network

Flexible Subscriptions

Leading the Way to the Next Architecture Paradigm

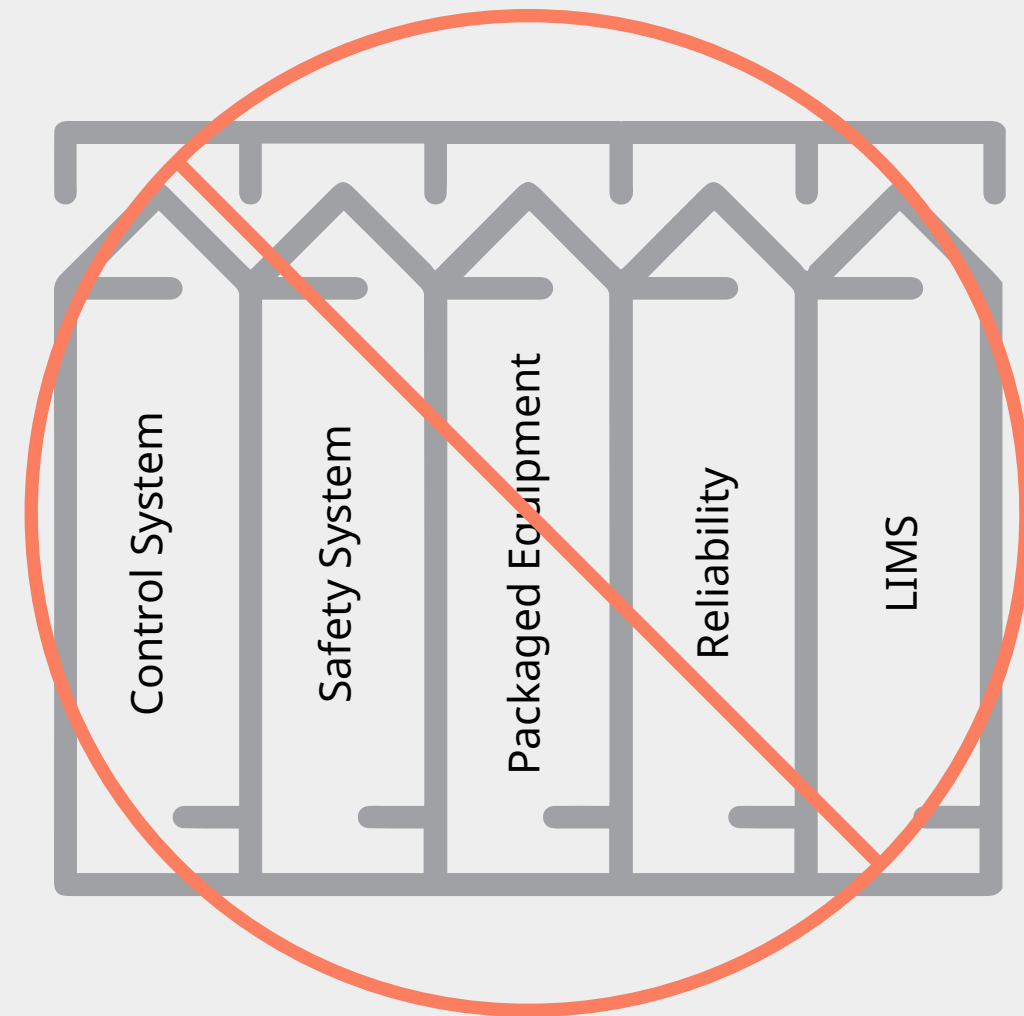
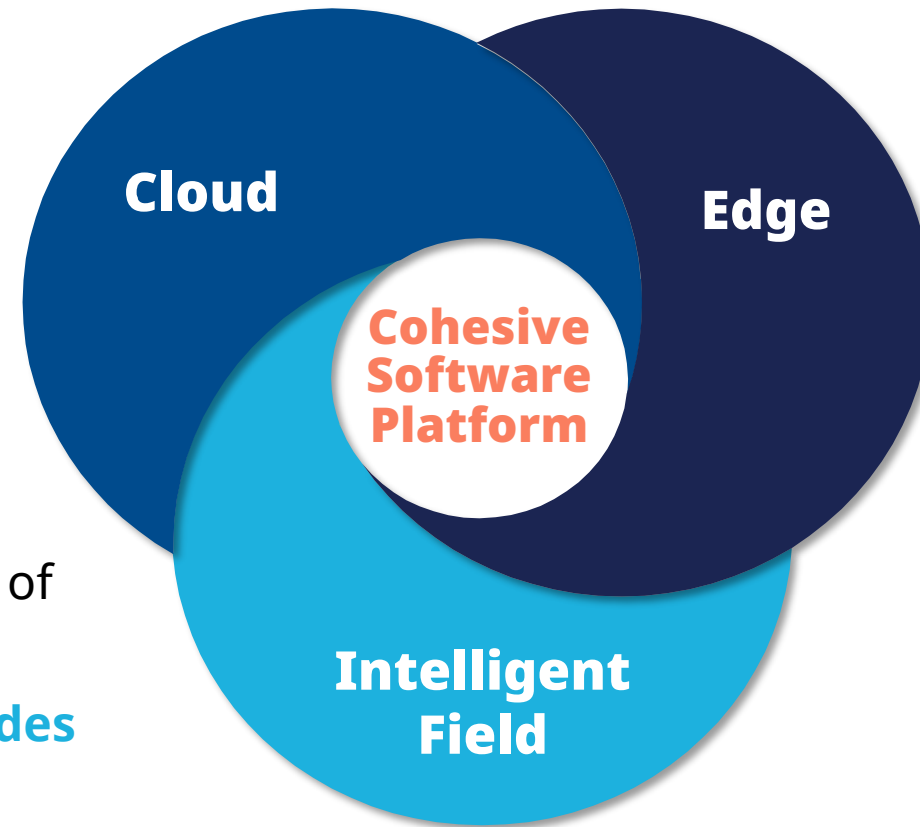
Boundless Automation

Flexible computing domains seamlessly interact and exchange

A common, consistent data model provides ease of use and application of usable data at all levels

Zero trust security architecture provides dynamic functional “zones” of authorization

Functional “systems” (control, reliability, etc.) as suites of software distributed across common compute infrastructure



Tomorrow's Automation Architecture: Connected and Boundless

Intelligent Field

The Intelligent devices continue to expand into domains other than automation and add applications and compute power

The Edge

The Edge securely places computing power closest to where it's needed

The Cloud

The Cloud provides infinite scalability, global connectivity, attractive lifecycle costs and rich analytics technologies

Devices connected to physical assets that include measuring or controlling elements of those assets; capable of digital connection

Computing devices hosted close to data generation; typically, where data has not traversed public internet

Remote banks of computing capability with an integrated compute fabric to host workloads; typically, external companies

Cohesive Software Environment

Common data models and API's drive customer ease of use, rich integration and solution-level security

A Cohesive Software Platform is Key to Unlock the New Automation Paradigm

Integrated by design

Ease of use

Data democratization

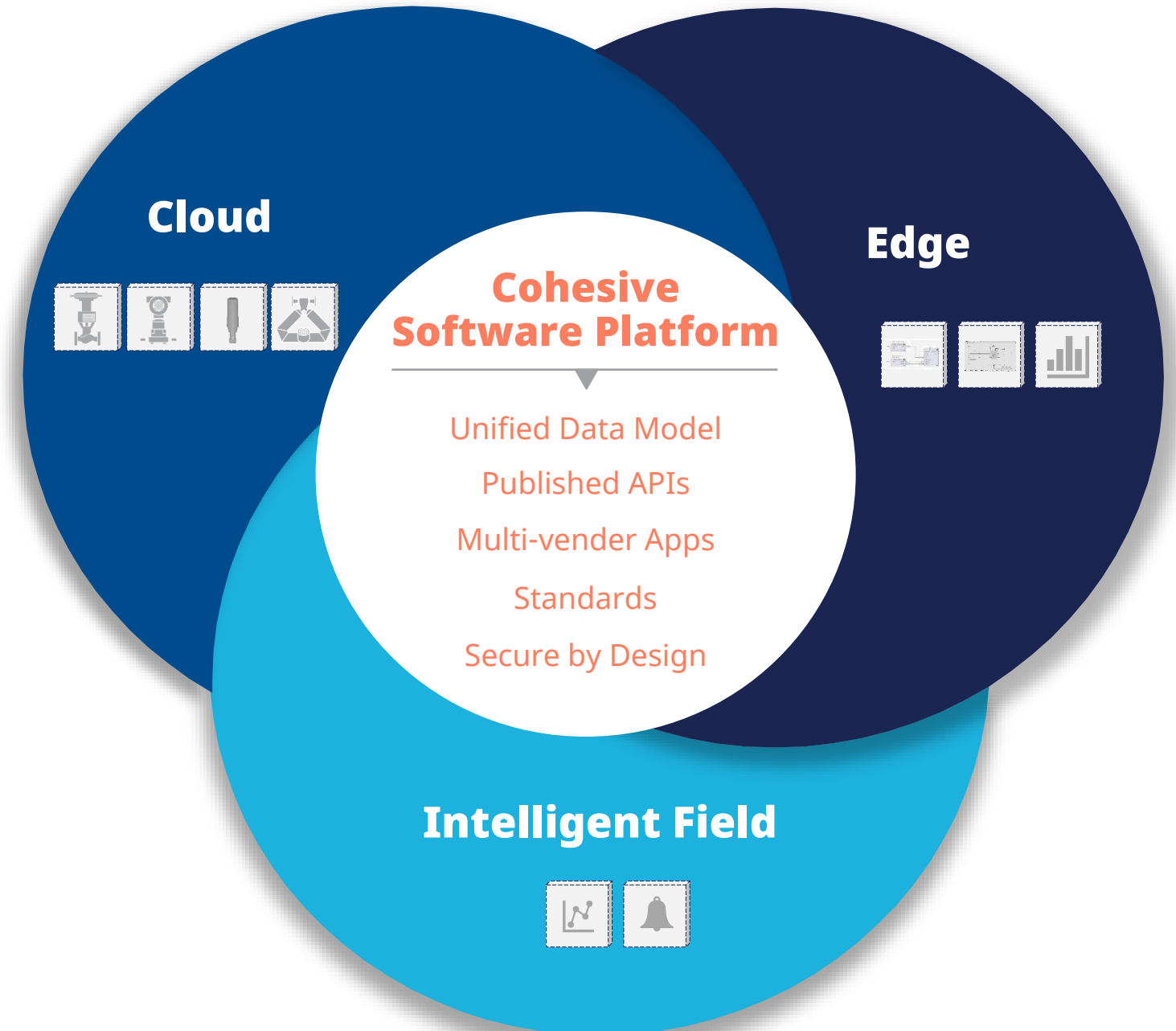
Solution level security certification

Unrestricted innovation

Interoperability

Extensibility

Unlimited Scalability



The Intelligent Field

Laura Schafer



Connectivity Options For All Applications Will Coexist in the Future

Discrete & Hybrid Manufacturing



Process



Distributed Assets



← The Field In Boundless Automation →

IO-Link



ethernet-apl™
advanced physical layer



PROFINET®

HART-IP

EtherNet/IP™

OPC UA

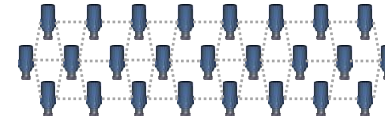
HART™
COMMUNICATION PROTOCOL



WirelessHART™



WiFi™



Wide Area Networks

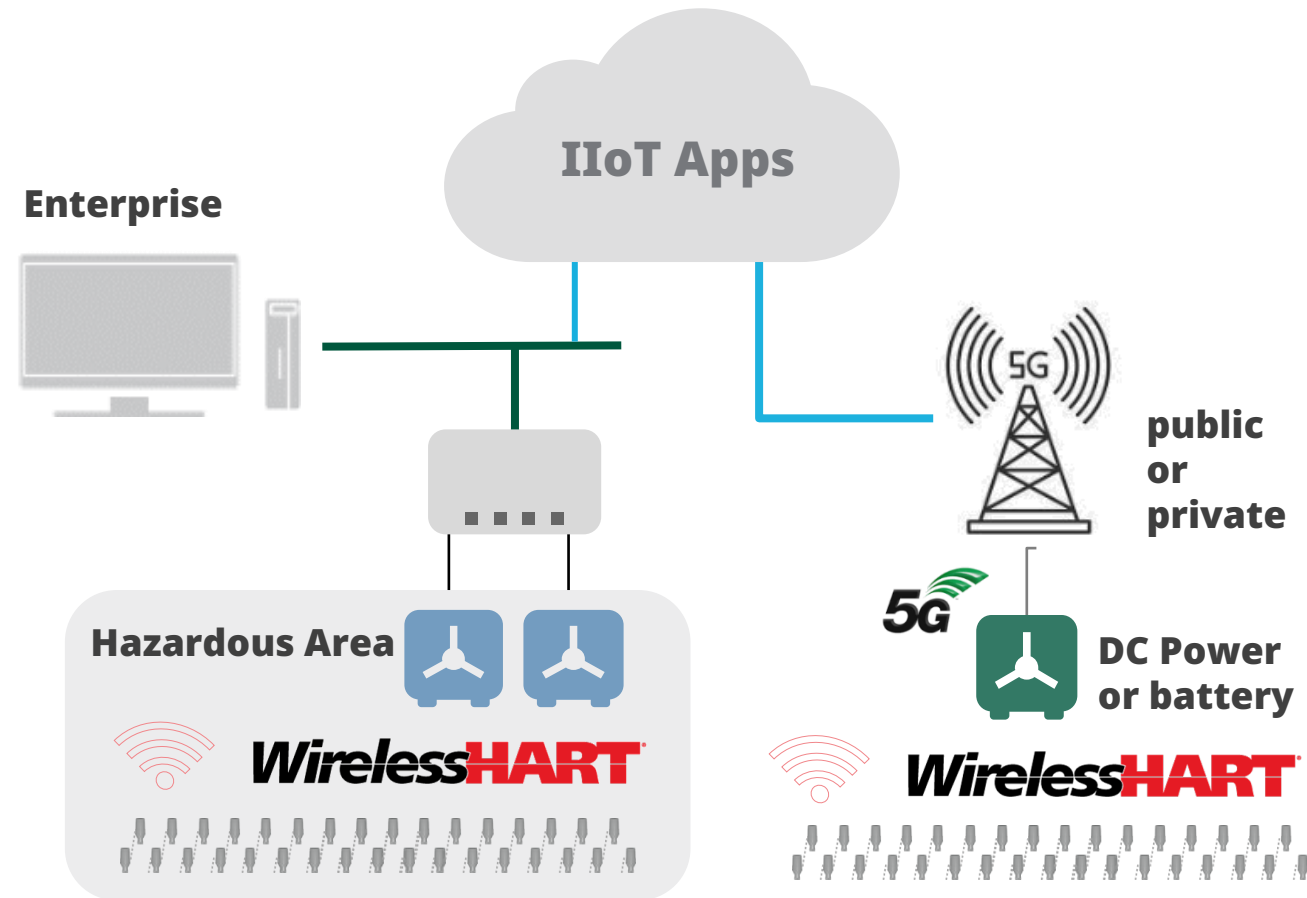


5G

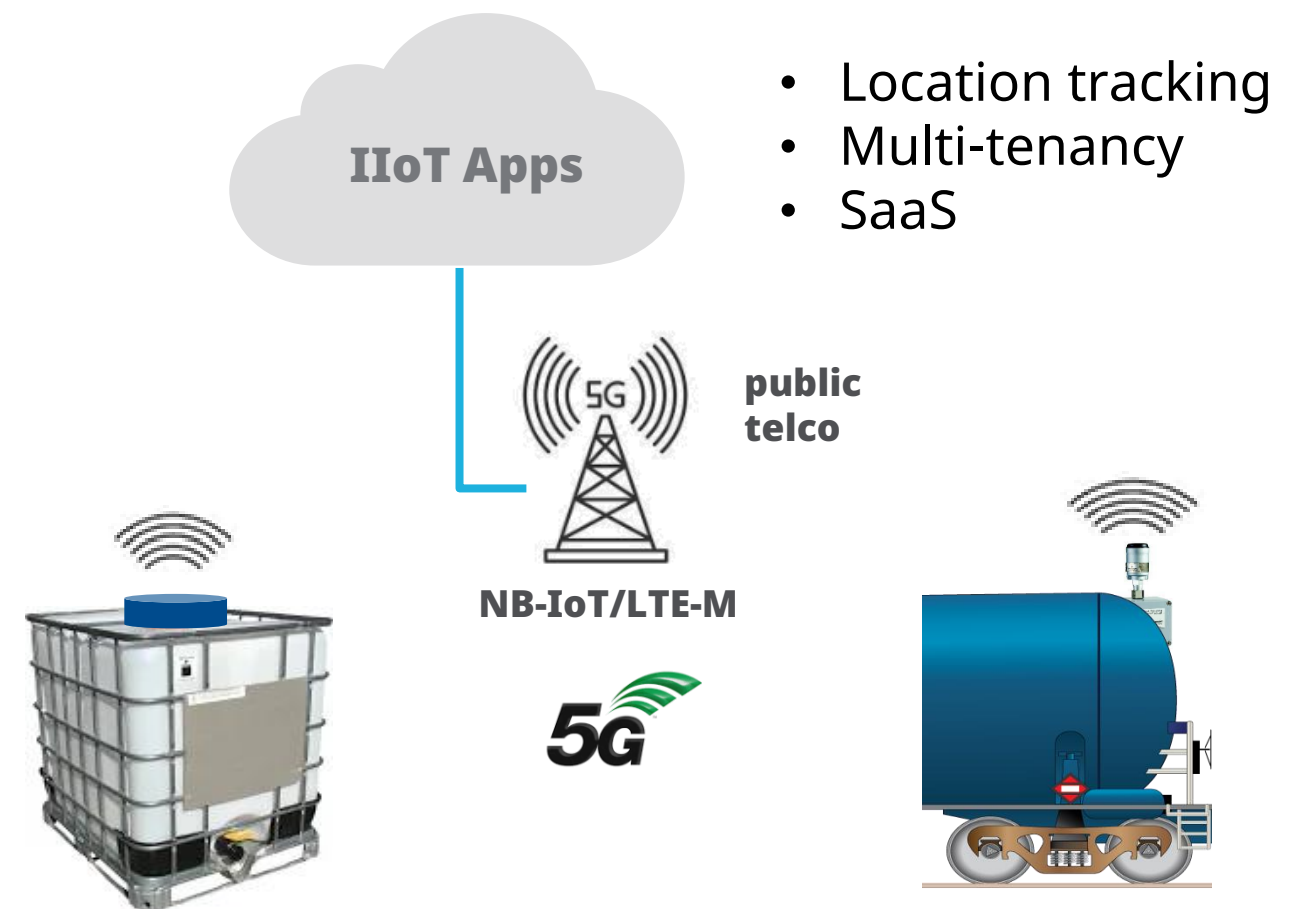


Wireless Devices to “Drop-in Data” for Pervasive Monitoring

Stationary High-Density IIoT



Mobile Single Asset



Customer Value

Increased density

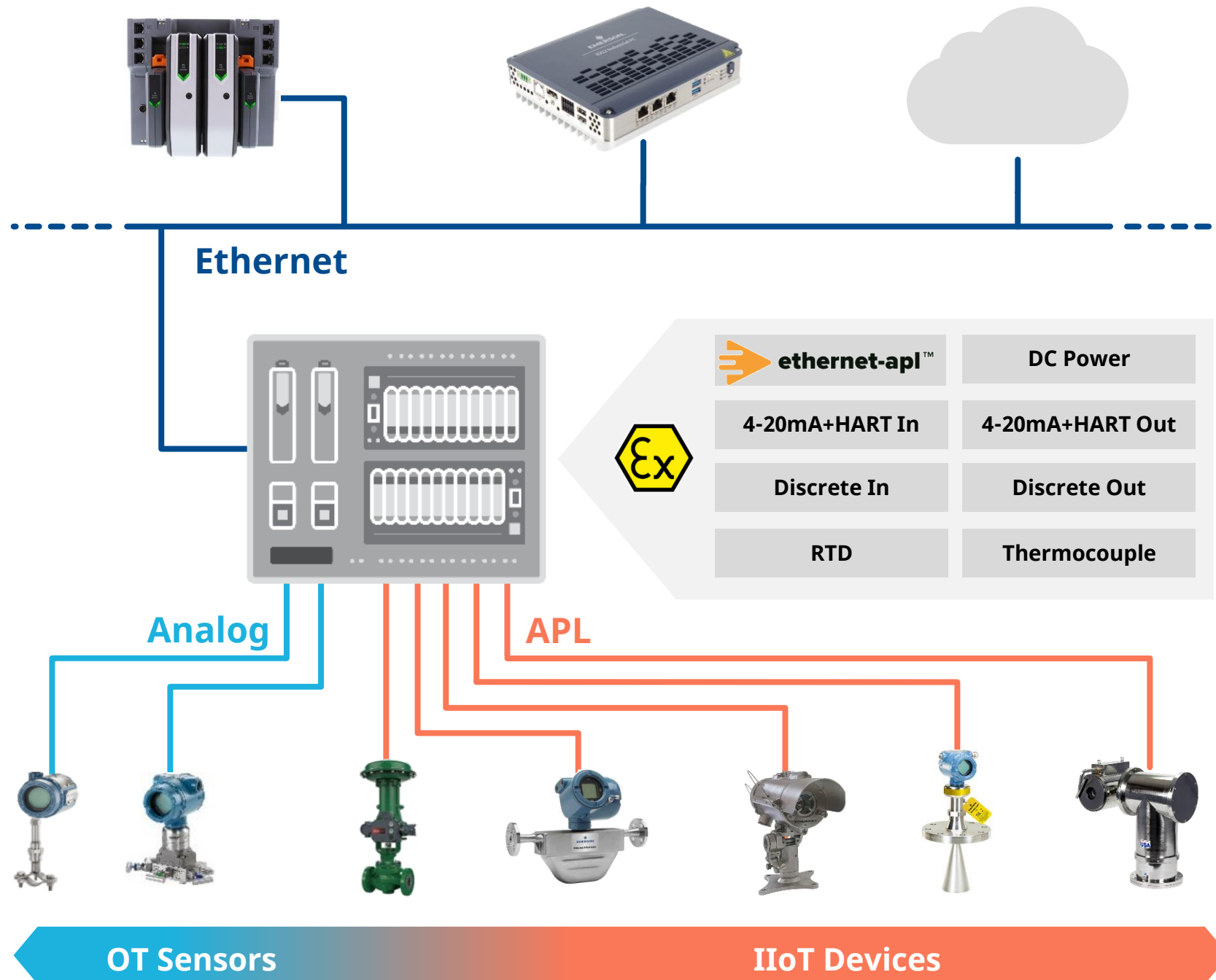
Longer range

Reduced cost

Geographically dispersed mobile assets

Communicate anywhere

APL Unlocks Ethernet in Hazardous Areas



Over 10 billion ethernet devices globally with numbers expected to triple by 2030

- Not in process environments

Traditional ethernet is not suitable for explosion hazardous locations

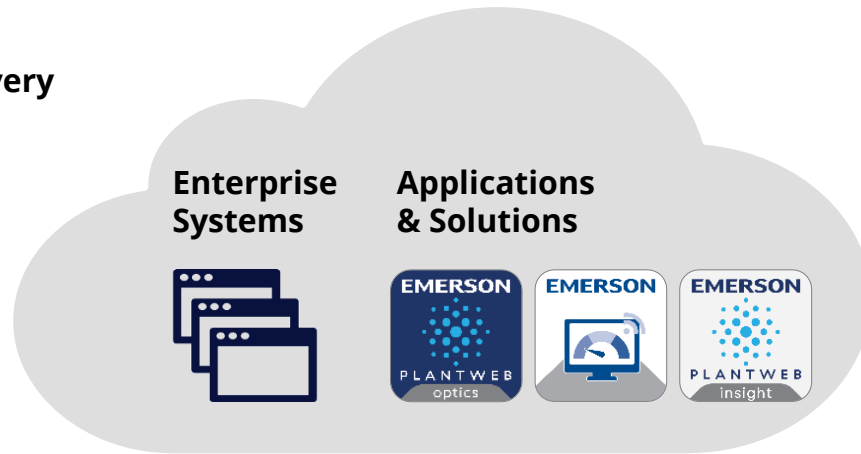
- Ethernet-APL is ideal for process environments

Easiest migration path with CHARMs

- An “APL switch” that can also input conventional analog signals
- Fully redundant backhaul
- Connects control, edge, and cloud
- Simple, fast, secure

Leverage of NAMUR PA-DIM Unified Data Model Will Enable Easy Integration

Persona Based Content Delivery



MQTT
PA-DIM

MQTT
OPC UA
PA-DIM

OPC UA
PA-DIM

FDI Data Server

Tank Level
Signal Quality
Interfaces



Temperature
Sensor Health
Process Alerts



Pressure
Sensor Module Temp.
Loop Integrity
Process Alerts



pH Level
Sensor Health
Process Alerts

OPC UA
Field eXchange (FX)

PA-DIM

Process Automation –
Device Information Model

Information model device 1

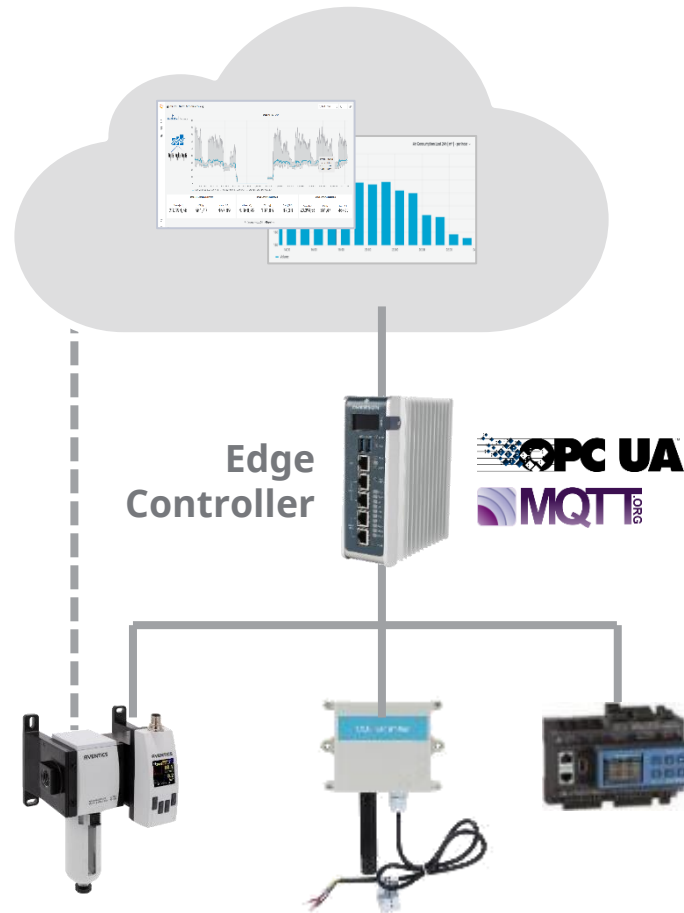
| Element | | |
|-------------------|-----------------|--|
| Device ID | Std. | } OPC UA companion std. "PA-DIM" |
| Device health | Std. "DI" | |
| Process variables | Class (profile) | |
| Services | Class (profile) | |
| Parameters | Class (profile) | } FDI, IEC 62769 |
| UI | Generic | |
| Business rules | Generic | } Vendor specific |
| | Proprietary | |
| | Proprietary | |

Greater Intelligence in Field Devices Delivers New Application Value

Valve Condition Monitoring



Compressed Air Optimization



More variables delivered from field devices

Computation and networking capability continues to grow

- Partnered with edge or cloud deliver new applications
- Field devices become edge platforms

Analytics run at device or edge have low latency, communication cost and privacy benefits

~Zero

Unplanned Downtime for Critical Valves

50%

Lower Major Maintenance Event Costs

\$80K/Yr

Average Maintenance Costs Savings

20-30%

Less Compressed Air Consumption



**Available for demo at
Technical Exhibit Hall**

The Cloud

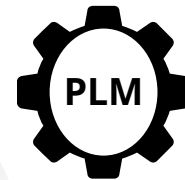
OT and Cloud

Cloud has conquered IT and will have an increasing role in OT

- Initial skepticism disappearing rapidly, driven by digital transformation programs
- Not just a HW platform but a computing model for software deployment and support
- Will bring IT benefits to OT, but with some data access challenges

Cloud providers adding OT-like services natively in the cloud

Information Technology (IT)
Enterprise Systems and Software



Non-Cloud-Native Software (SaaS as IaaS)

New Cloud-Native Software (PaaS)



OPERATIONS(OT)
Automation Systems and Software

Cloud vendors are offering horizontal applications

- Based on data
- Offered as SaaS



Azure Time-Series Insights



Azure IoT Hub



OT suppliers will continue to offer domain-centric applications

- Based on domain expertise
- Offered on-prem or SaaS



Process Control Applications



Process Simulation

Cloud Enables OT to Enjoy IT Value Proposition

Vendor takes on infrastructure
and some cybersecurity responsibility

No software to deploy on clients

Universal access from multiple clients

Elastic scalability

Pay as you go



Enterprise Level Coverage, Capability, & Access

Unified data model enables easy enterprise application development

- Consolidated reporting and dashboarding
- Compare and contrast performance of various plants

Integrate OT data with enterprise functions

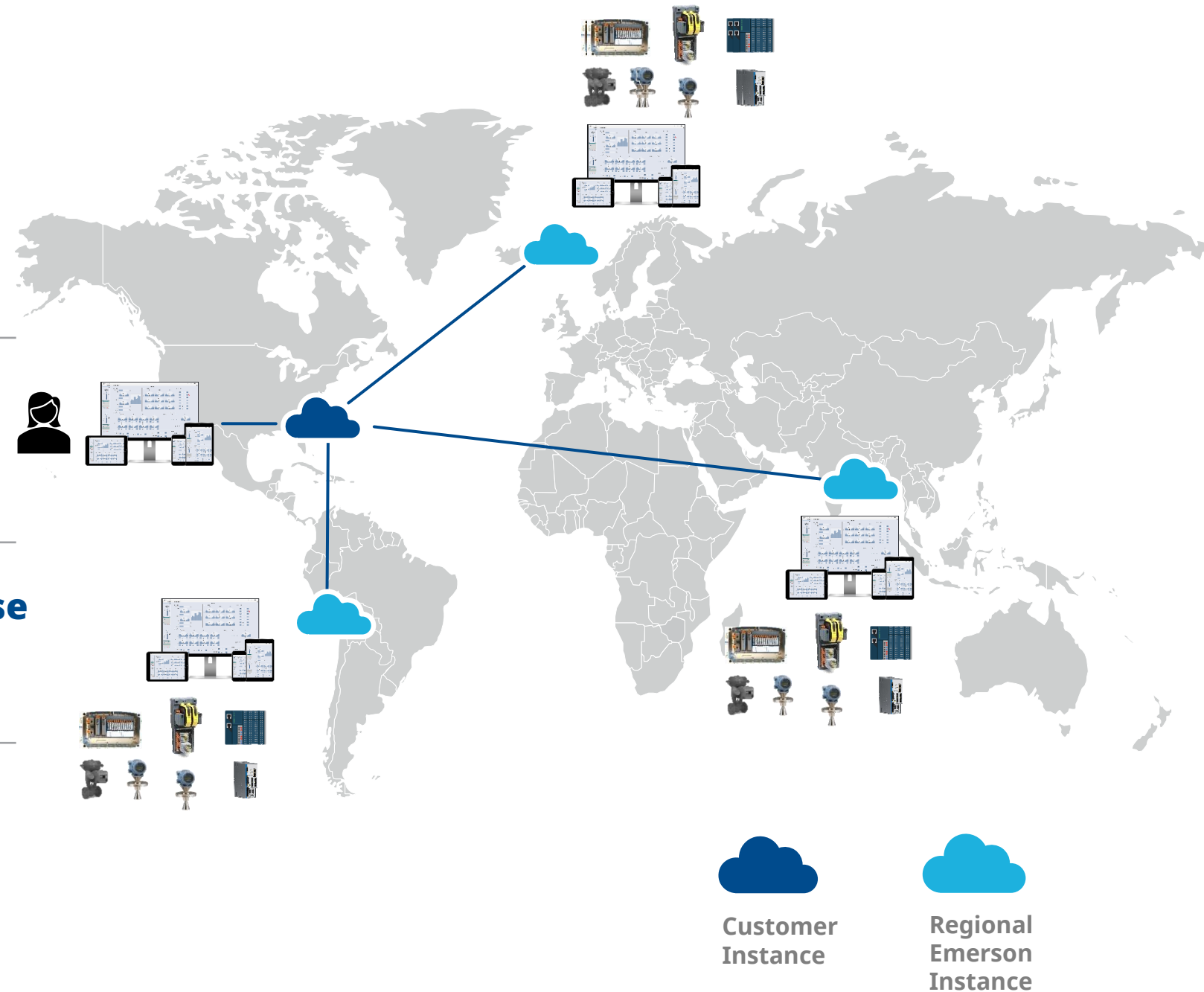
- Business level optimization

Centralized expertise leveraged across the enterprise

- Both in-house and external partners

Operational redundancy

- Secure visualization anywhere



Cloud Enables On-Demand, Tailored Customer Support

MyPreferences

"I want to set new preferences so my experience can be tailored to what I like"

Key capabilities

Manage communication and account preferences.

MyTraining

"I want to select relevant training courses and have a central place to access them"

Key capabilities

Manage purchased courses and training records. View recommended courses.

MySoftware

"I want to access, download, and manage my licensed software"

Key capabilities

Manage cloud and downloadable software licenses. Easily view upgrades and hotfixes.

MyWorkspace

"I want help sizing a DP flow meter, including a CAD model so I can quickly check dimensions"

Key capabilities

Increase efficiency with engineering tools to size and configure, generate drawings, and collaborate.

MyTransactions

"I want access to my organization's quote and order history for faster transactions"

Key capabilities

Improve digital commerce processes with visibility to price, quotes, and order history.

MyAssets

"I want to access, download, and manage my licensed software"

Key capabilities

View asset records to access product documents, order spare parts, and schedule service.



Cloud Technologies Have Revolutionized Software Development and Deployment

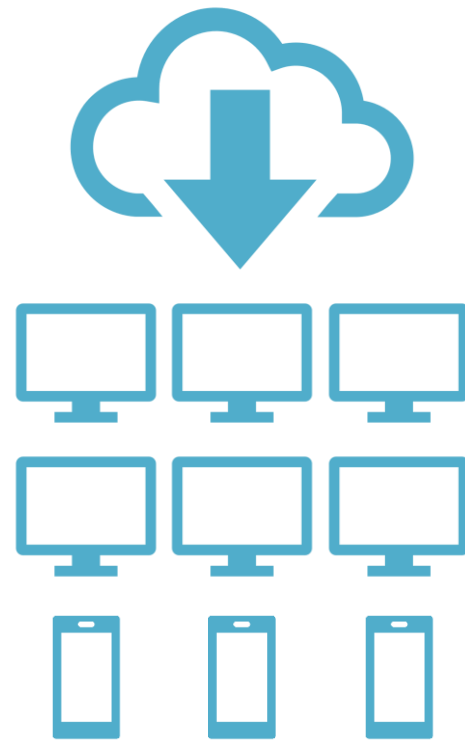
Containers

Modular deployment, functionality and security



Fleet Management

Orchestrated provisioning and upgrade of entire software fleets



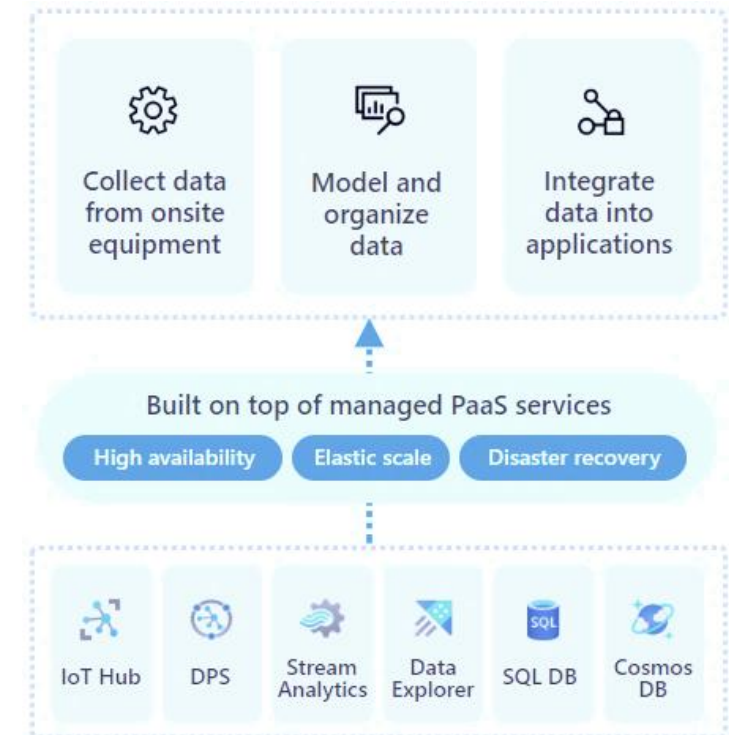
Multi-Tenant Capability

Lower execution cost and provides single instance upgrades



SW Platform-as-a-Service

Speeds app development and outsources software infrastructure management



Edge

Claudio Fayad

The Edge is a New Paradigm for Software Workload Deployment and Connection

Leverages Cloud Technologies

Built on Current OT Infrastructure

Deploys Software as Orchestrated Workloads

Redefines the Communication Architecture

Data Centric

Secure by Design

The Edge is where IT and OT innovation come together

Emerson and AspenTech Have Enabled the Evolution of the Industrial Edge with Distributed Compute Nodes, Smart Protocols and Cohesive Software Environment

Cohesive Software Environment



Subsurface Modeling



Operations & Alarm Management



Advanced Process Control



Planning & Scheduling



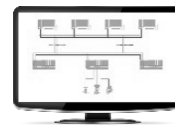
Plant Asset Management



Control Engineering



Training, Simulation, Digital Twin



Real-time Optimization



Advanced Distribution Management



Asset Performance Management

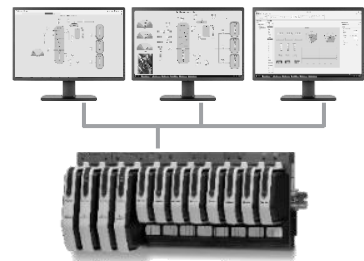
Engineering & Design

Control & Optimization Software

Production Management

Asset Reliability & Performance

Compute Nodes



Process Control & Safety Systems



Energy Transportation



Discrete And Machine Control

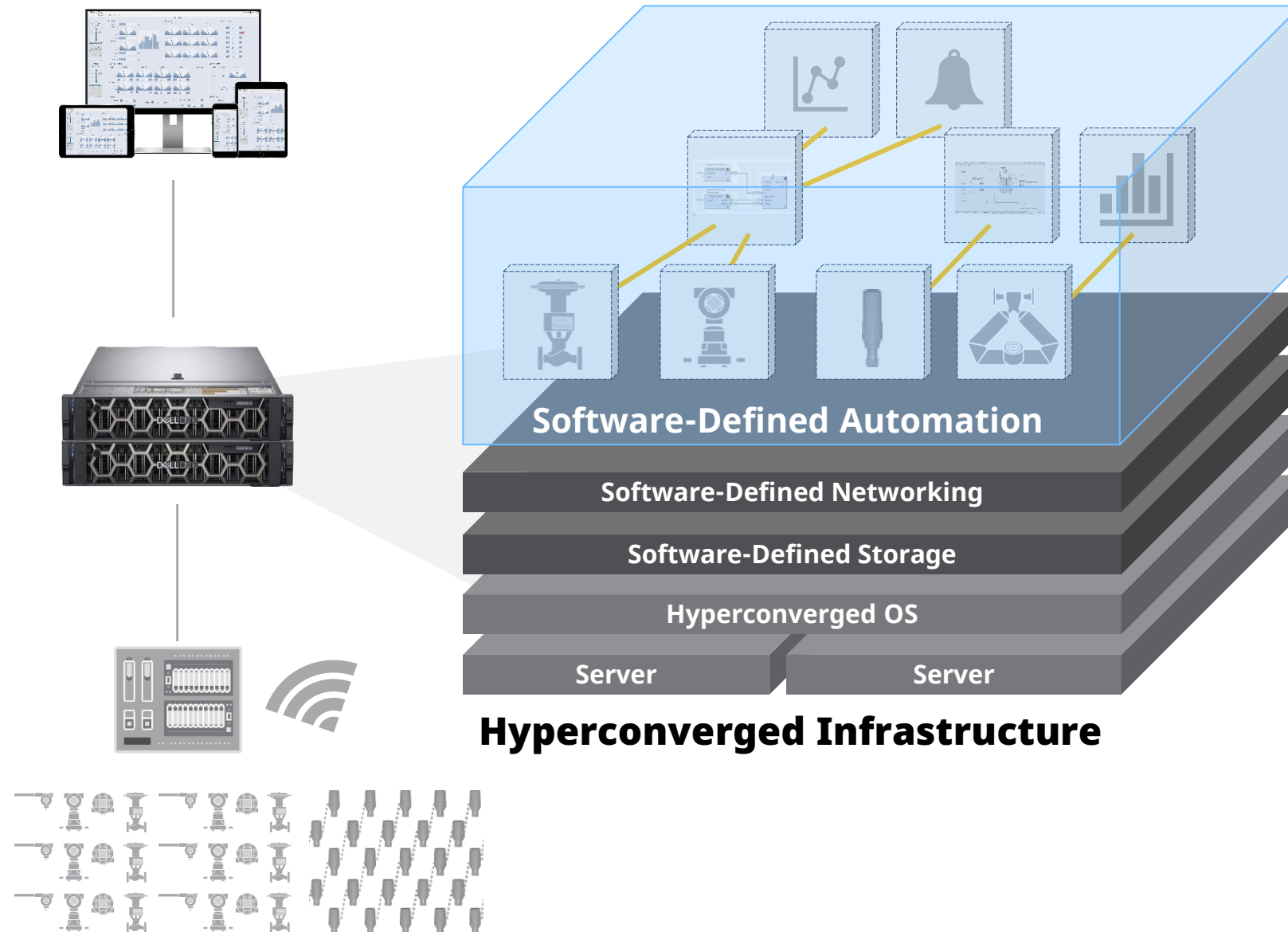


Machinery Health & Protection

Smart Protocols



The Edge Automation Environment Removes Functional Silos, Converging Embedded Functionality as a Software-Defined Workloads



Containerized Automation Functions

On-Demand Scalability

Fault Tolerance & Redundancy

Easy Deployment & Upgrades

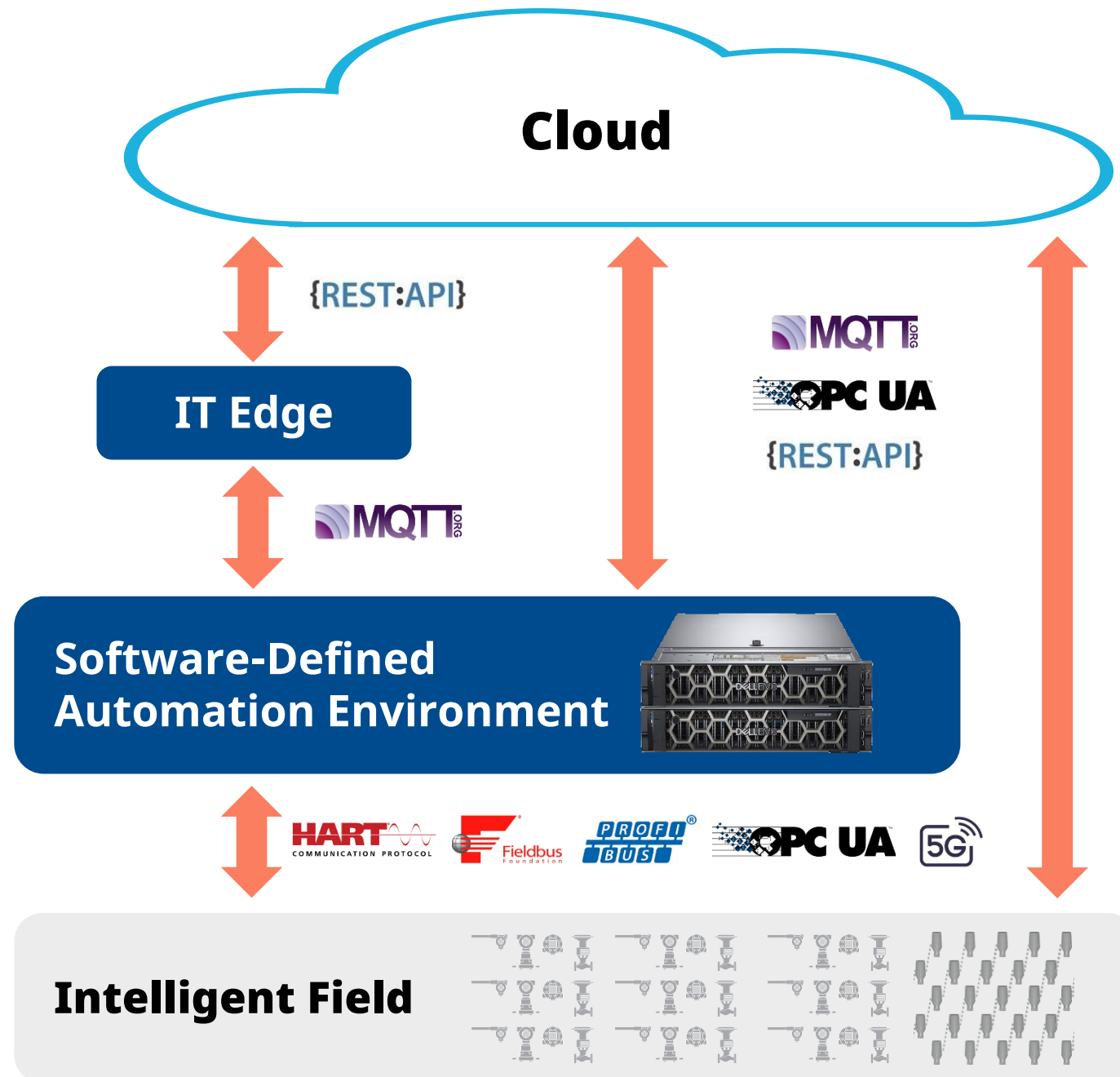
Improved Performance

Efficient Data Distribution



Available for demo at Technical Exhibit Hall

A Flexible Connectivity Approach Eliminates the Silos Created by the Purdue Model



Remove horizontal silos

Eliminate bottlenecks

Combines OT and IT protocols

Adapts to required latency

Enable workloads to be executed on most effective locations

Increases data accessibility

Data Democratization Requires an Integrated and Contextualized Data Model

Data Silos

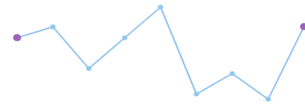


Real Time Data

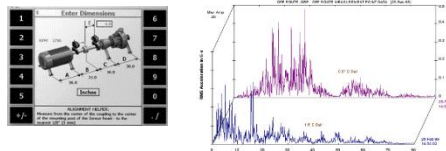
| | |
|-------------|------|
| Flow | 100 |
| Temperature | 50 C |



Historical Data



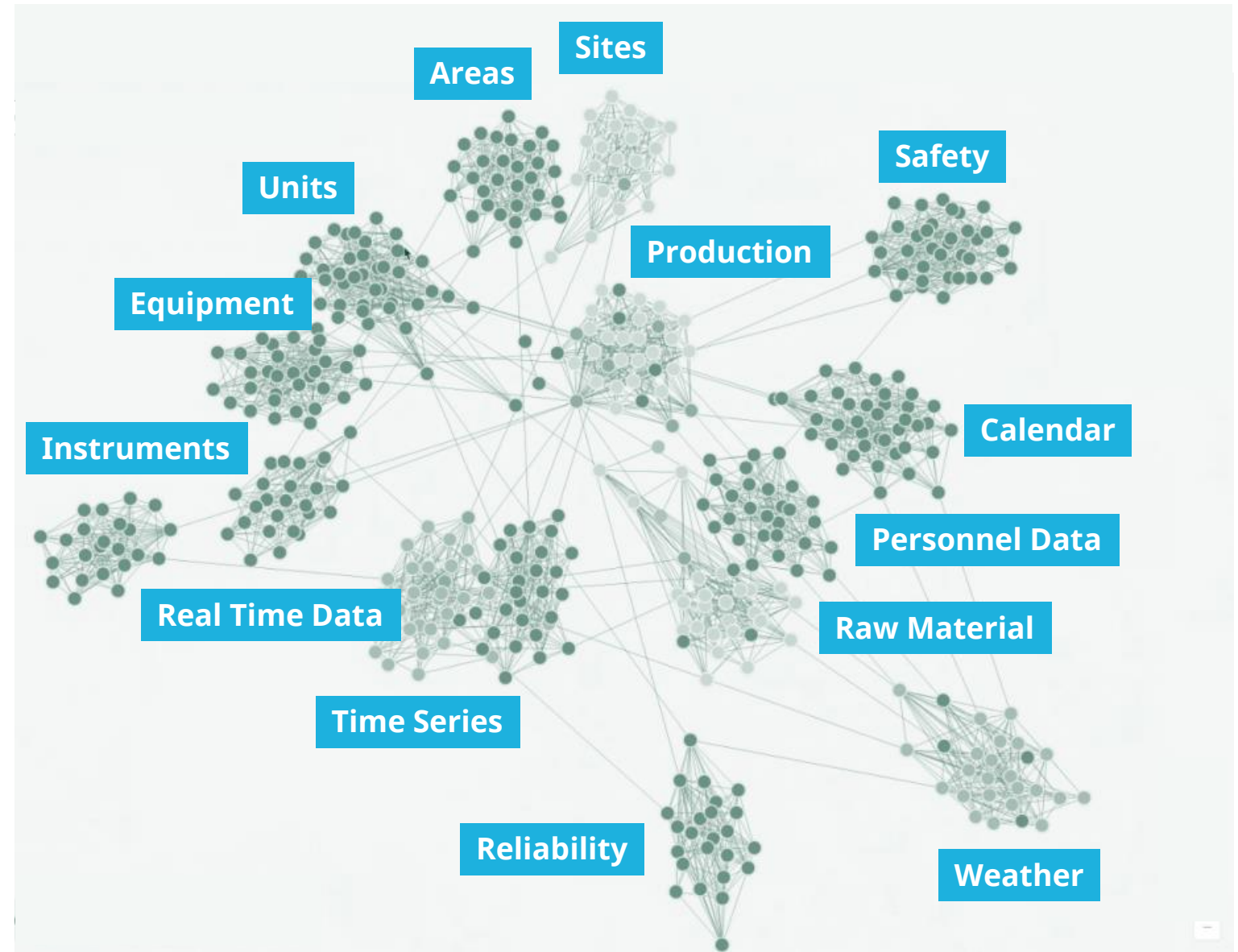
Reliability Data



Production Data



Unified Data Model



Knowledge Base

What Happened to My Plant Today???

Data Silos

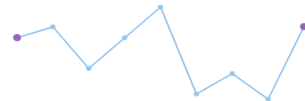


Real Time Data

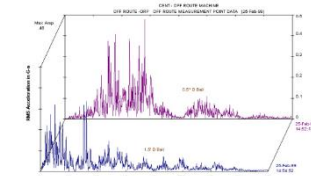
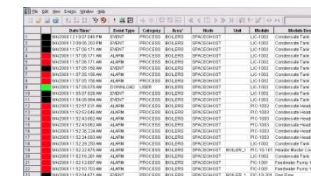
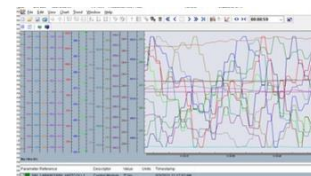
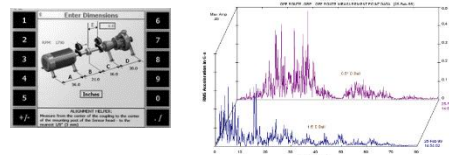
| | |
|-------------|------|
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| Temperature | 50 C |



Historical Data



Reliability Data



Production Data



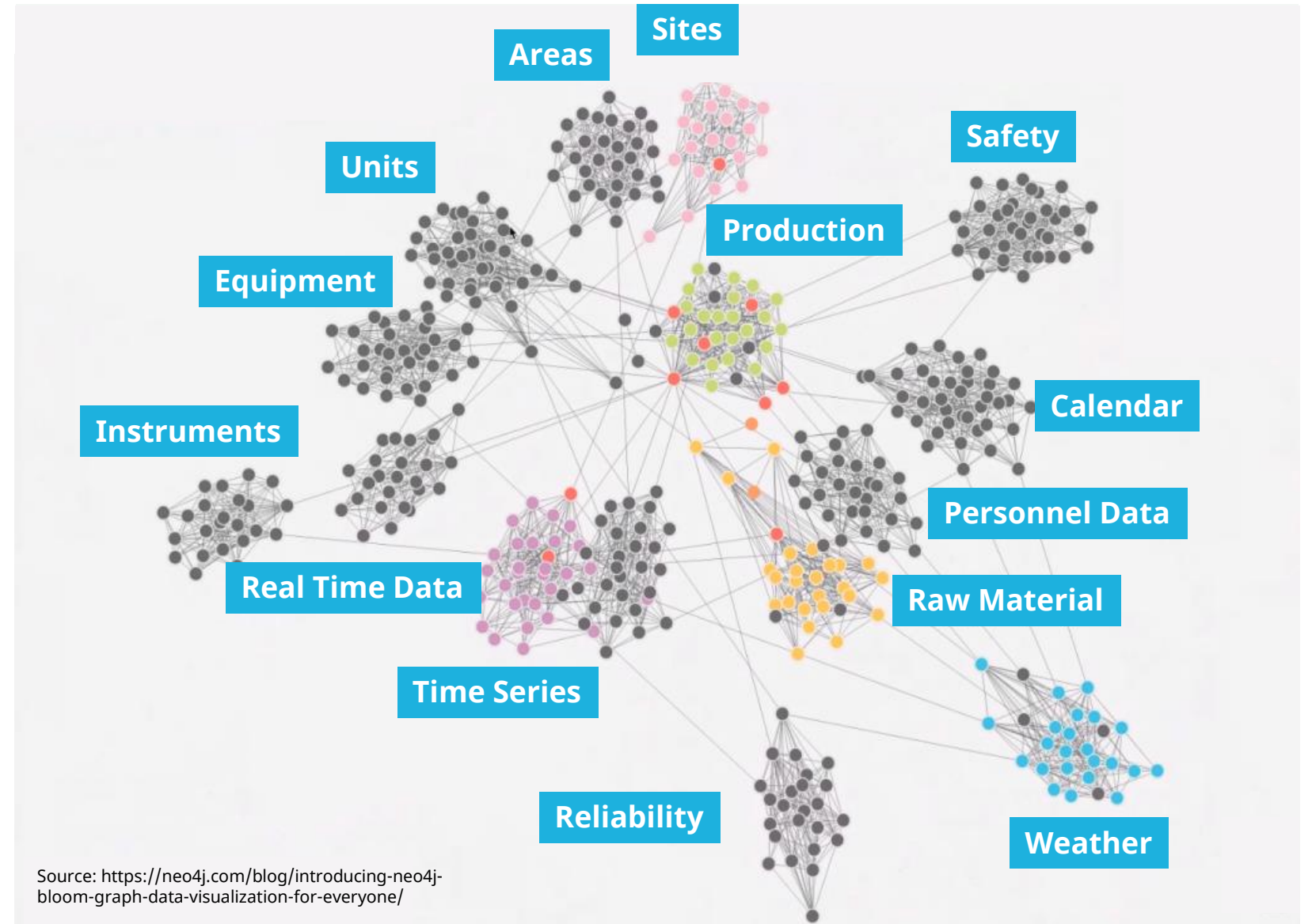
What Happened to My Plant Today???

The Yield Today was **95%** due to an Unexpected Shutdown of Unit A.

There were **3 alarms** on Unit A before the shutdown associated with instruments connected to **Pump 101**

The Unexpected Shutdown was most likely caused by a combination of lack of lubrication and inclement weather, causing excessive vibration on the pump

Unified Data Model

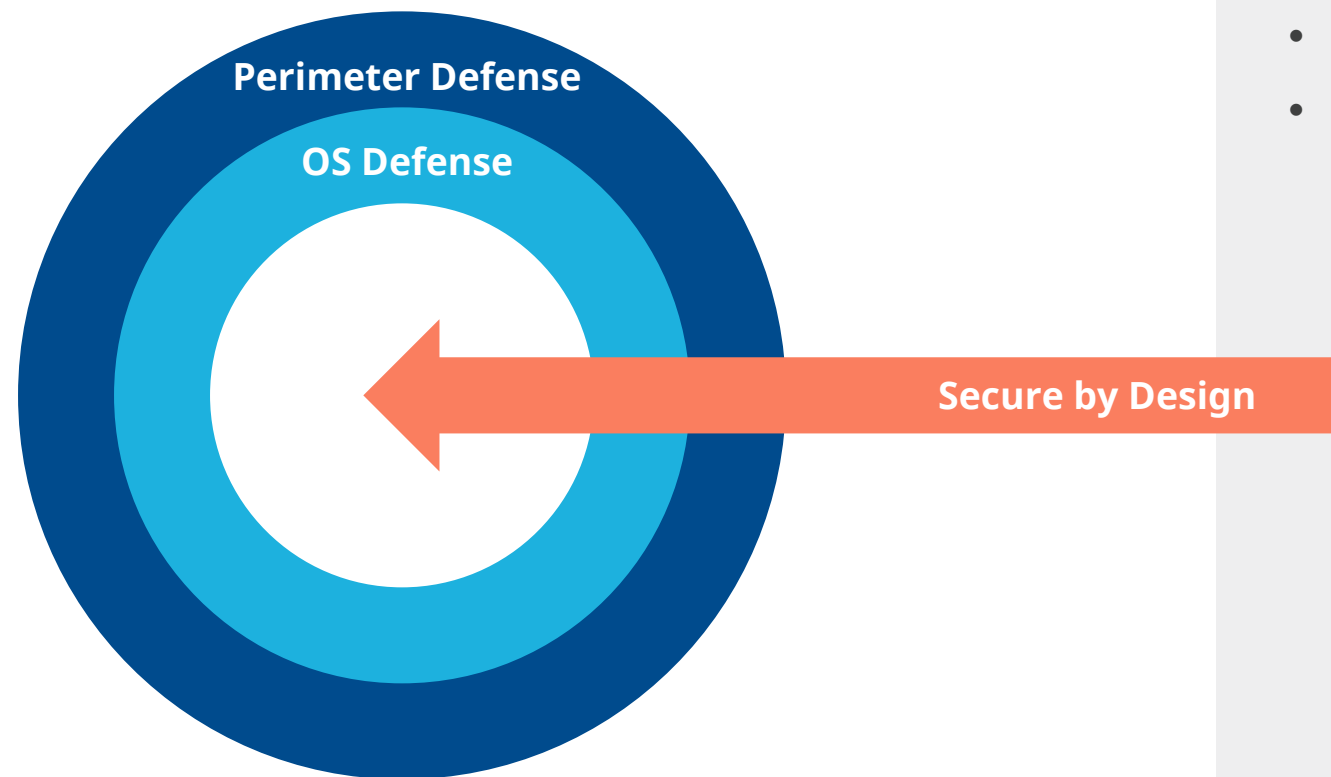


Knowledge Base

“Secure by Design” Augments Traditional “Perimeter Defense” to Enable Easy, Next-Level Cybersecurity in a Hyper-Connected Ecosystem

Traditional Approach – Perimeter Defense

- Antivirus & Allow-Listing
- Secure Remote Access
- Two Factor Authentication
- USB Protection
- Smart Firewalls
- Smart Switches
- Backup & Recovery
- Integrated Patch Mgmt.
- Security Info & Event Mgmt.
- Network Security Monitor



New Additional Protection – **Secure by Design**

Secure Development

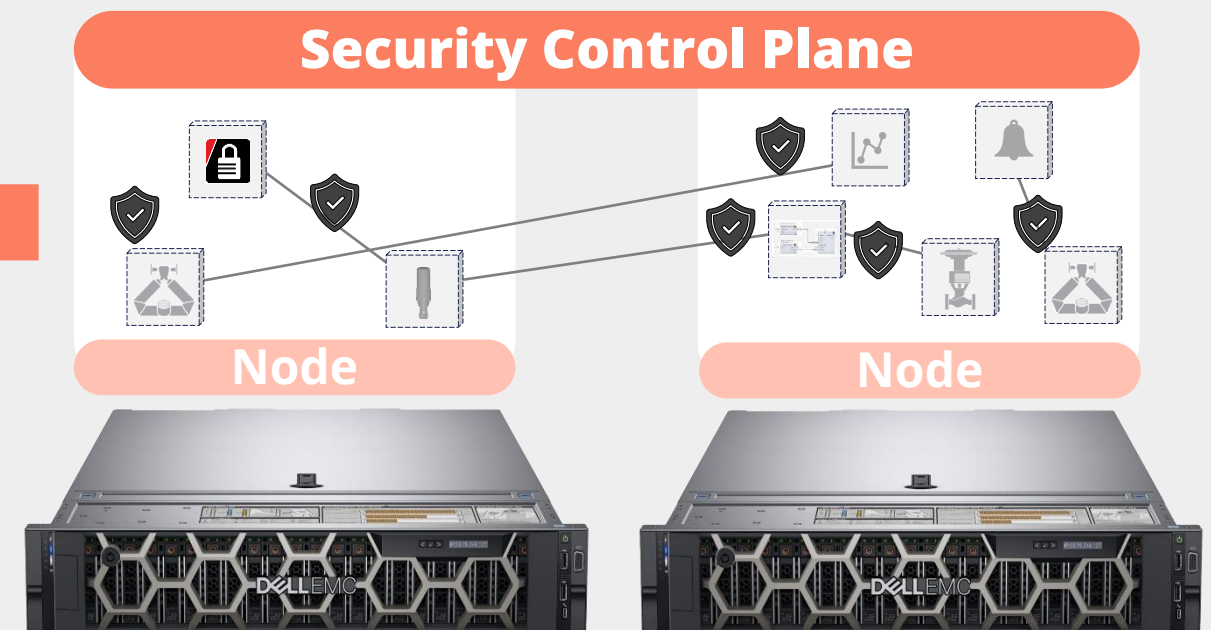
- All Developers Trained
- Assess and Monitor 3rd Party Software
- ISA Secure Certified

Containerized Isolation

- Isolated Secure Sandbox
- App Containerization

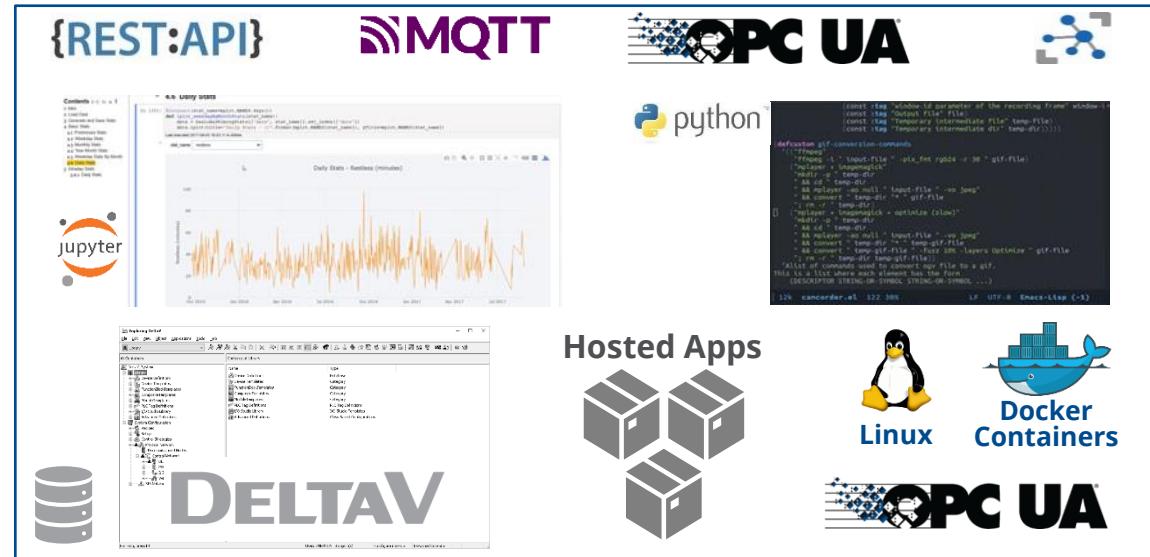
Zero Trust Architecture

- No Intrinsic Trust
- Encrypted Communications
- Node Authentication
- Only Pre-Approved Connections



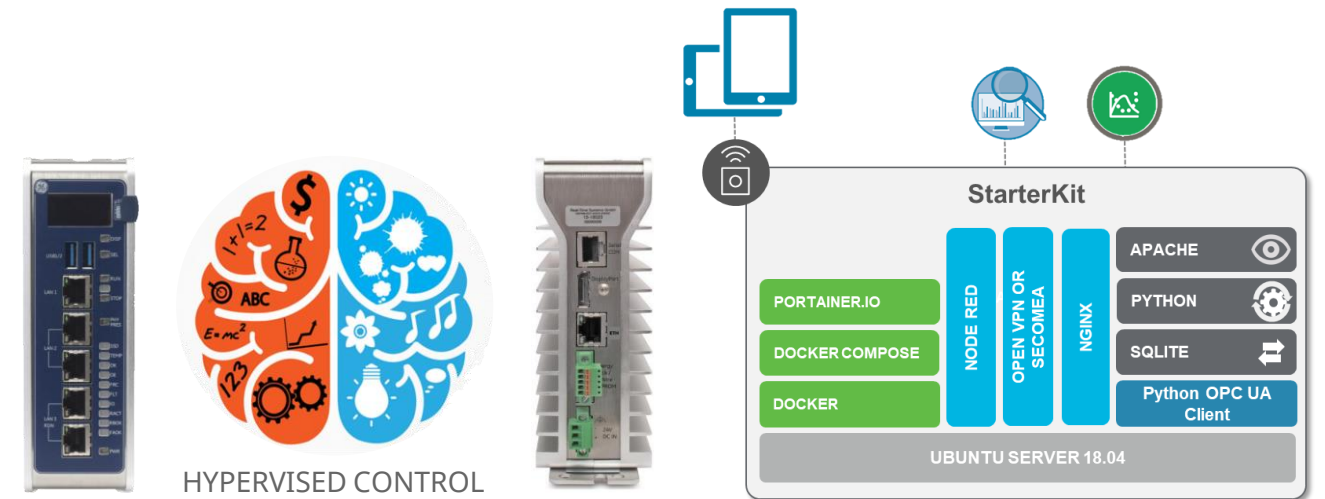
The First Products are Focused into Connectivity and Extensibility

DeltaV Edge Environment



- Secure replica of DeltaV data and context
- Secure sandbox to run analytics and custom code
- Connectivity with Cloud and other Edge Workloads

PAEdge



Edge Controller

IIoT Software

- Integrated real-time and non-critical workloads without compromise
- Connect islands of automation



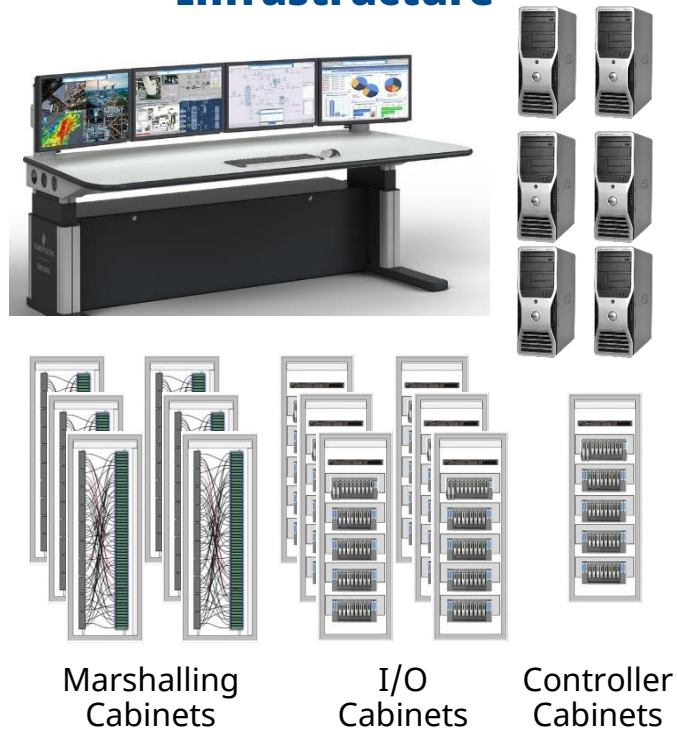
Available for demo at Technical Exhibit Hall

The Future Automation System is Software-Defined, Data-Centric & Flexible Enterprise Ops Platform

1995-2010

Operations Mgmt. Software
Automation Software

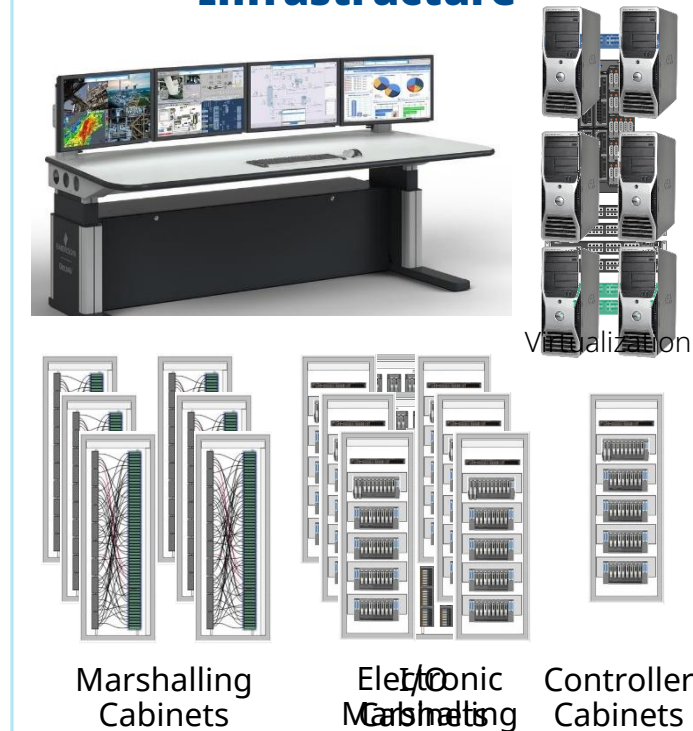
Automation Infrastructure



2011-2018

Operations Mgmt. Software
Automation Software

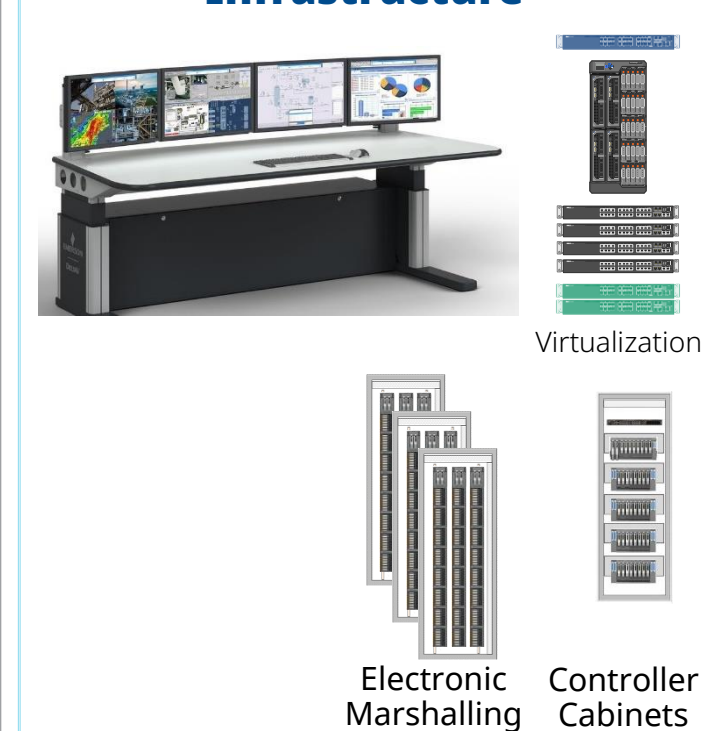
Automation Infrastructure



2018-Present

Operations Mgmt. Software
Automation Software

Automation Infrastructure



Automation Edge

Enterprise Operations Platform



Operations Anywhere

Software-Defined Infrastructure



Summary

Industrial Automation Architecture

Now vs. Future

Now

Siloed system architectures

Data islands

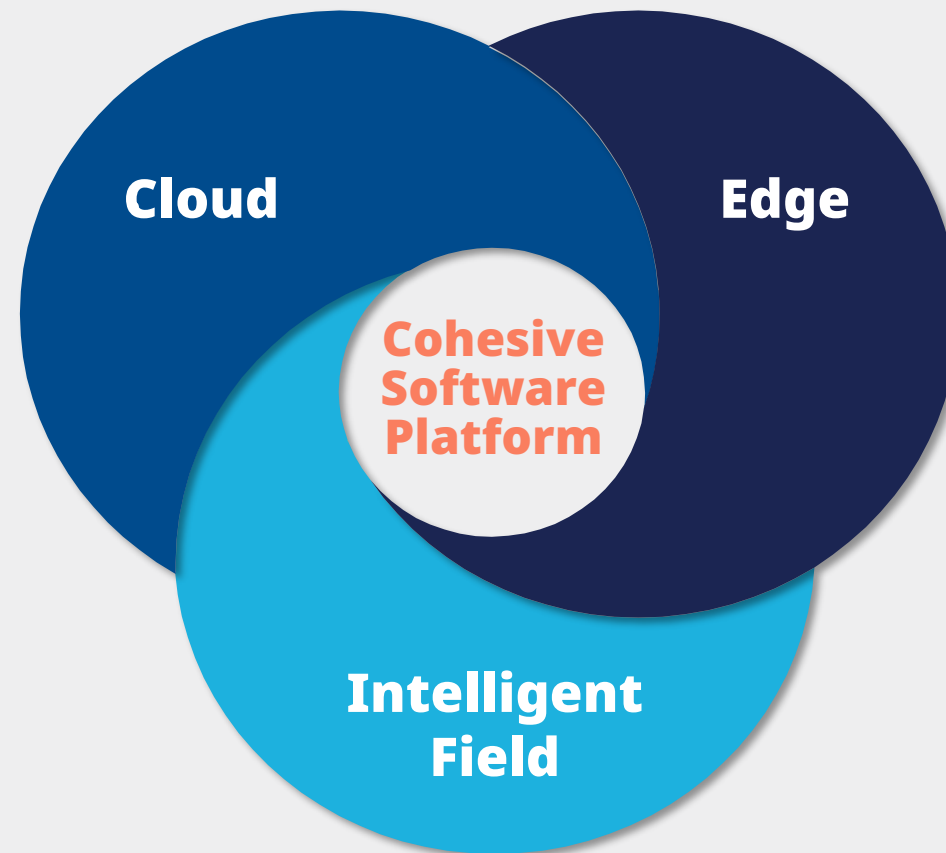
Cybersecurity defense in depth

Hardware-centric perception

Device administration

Single-site operations

Mostly CAPEX



Future

Boundless Automation

Unified data model

Inherently secure by design

Software-defined and data-centric

Fleet administration

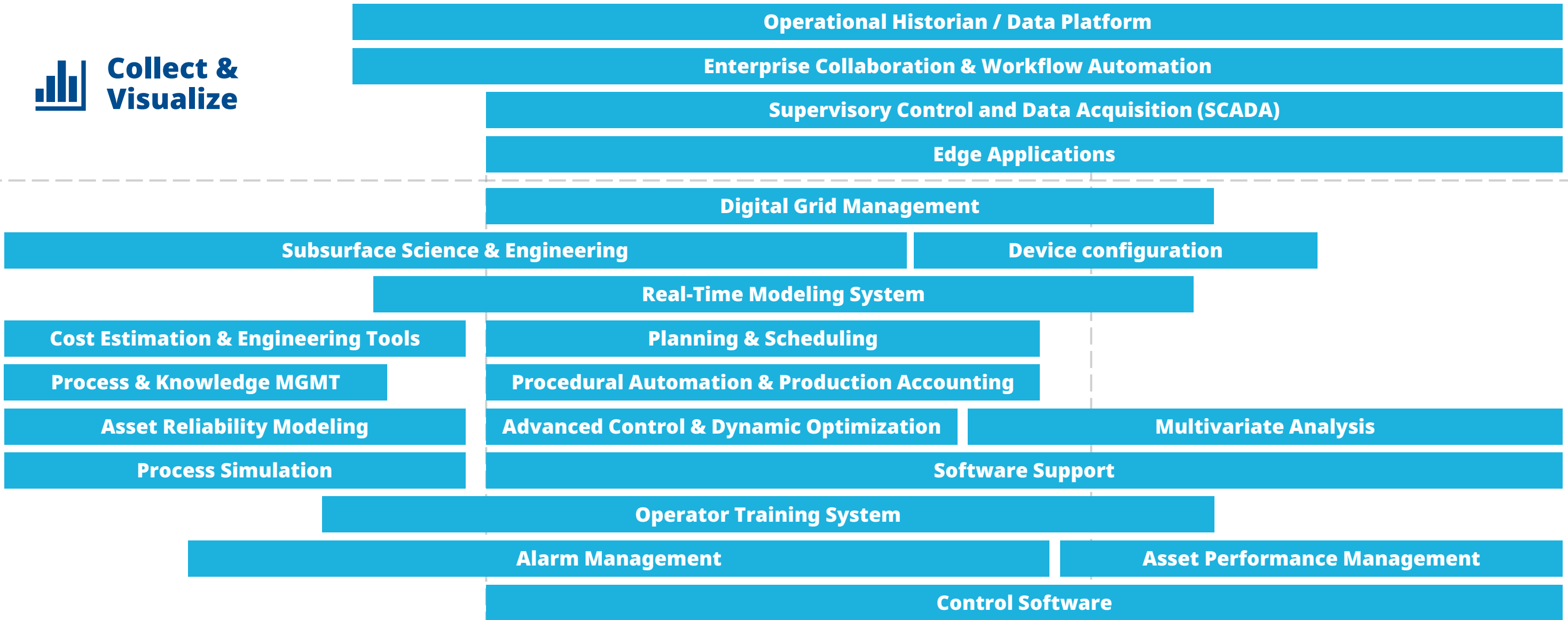
Cloud-enabled enterprise operations

Mostly OPEX



Emerson and AspenTech Form a Unique Opportunity to Unify the Broadest Suite of Best-in-Class Software on a Next-Gen Software Platform

 **Collect & Visualize**



 **Design & Plan**

 **Operate**

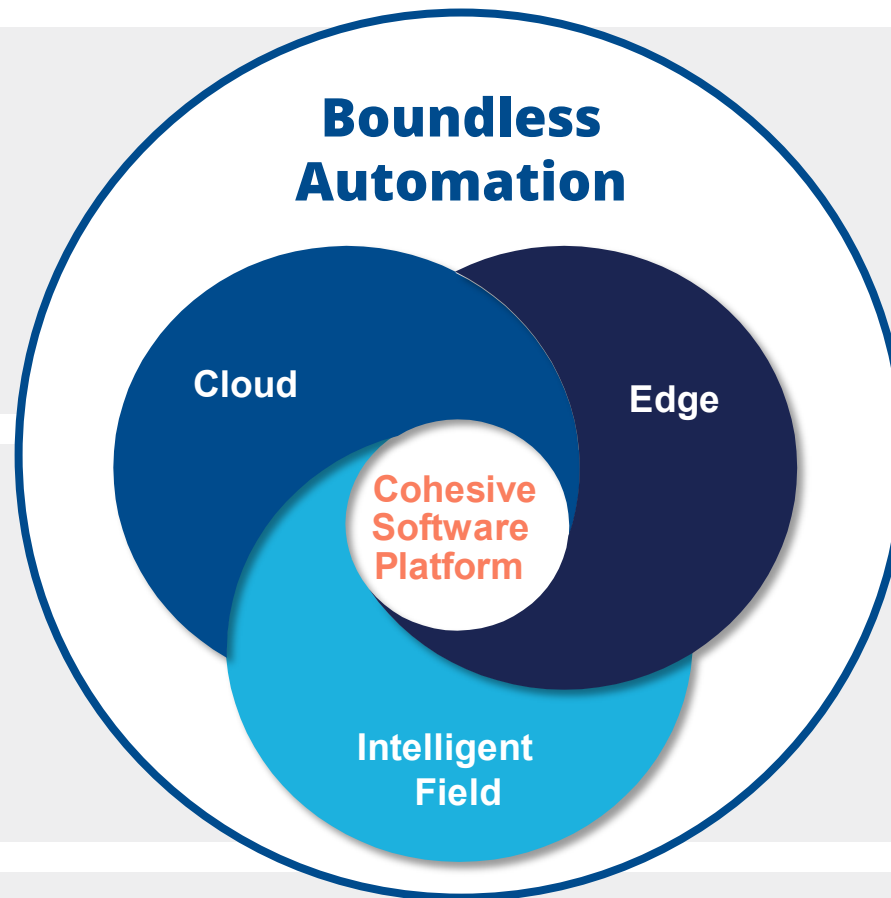
 **Maintain**

Safety



Zero injuries.
Zero incidents.

Boundless Automation



Reliability

No unplanned downtime
at minimal cost

Production



Production optimized
to market conditions



Sustainability

Recognized
sustainability leader



Workforce

Empowered digital workers drive even more value

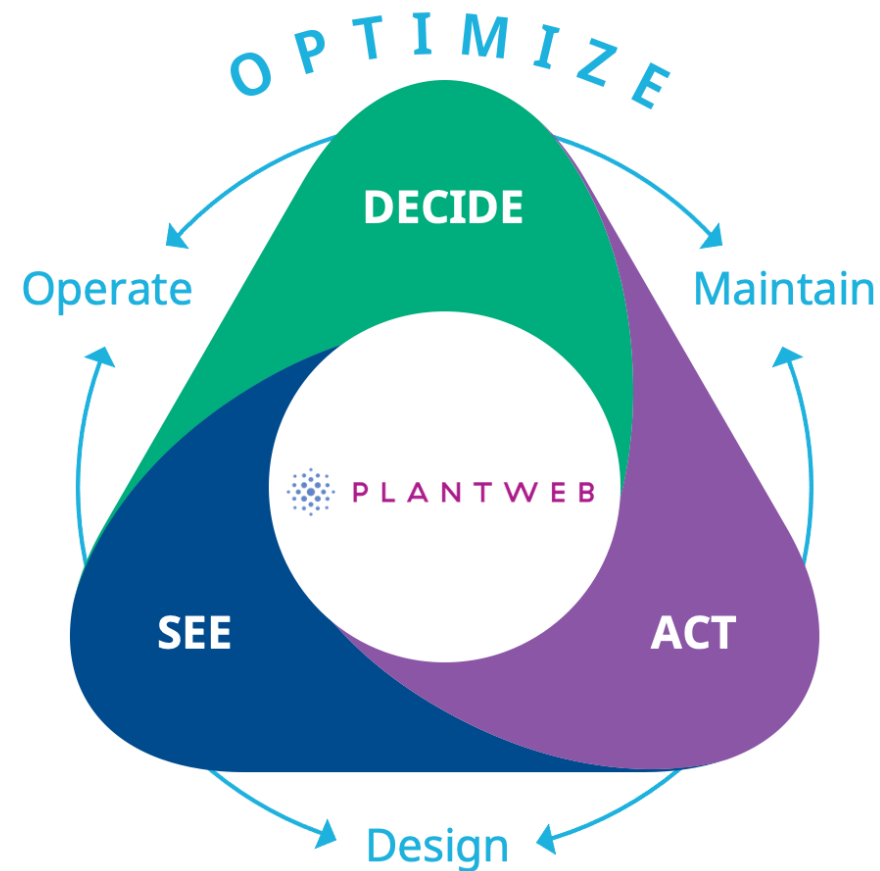


**Truly optimizing operations requires
tensioning multiple domains
simultaneously**

Enabled by uniform data access
and context across the enterprise

**New computational architecture allows
optimal execution based on specific
requirements**

Inherent security, fleet deployment and support,
elastic scalability and software defined



The Plantweb Digital Ecosystem Powers World Class Performance

Sensing & visualization

to optimize insight and decision making

Predictive diagnostics & monitoring

for maximum asset reliability

Precision control

to ensure safe, responsive operations

Modeling & AI-powered analytics

for performance optimization



Q&A