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6-1701 Merck’s Modern Approach to Modular Pilot OT Integration for Process Automation

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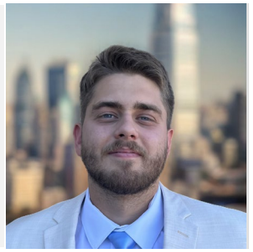

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Continua Process Systems

Continua is a team of 60+ NJ-based OT & Process Experts helping labs, plants, and enterprises successfully digitally transform in the Industry 4.0 era.

Merck & Co., Inc., Rahway, NJ, USA

For more than a century, Merck has been at the forefront of research, bringing forward medicines, vaccines, and innovative health solutions for some of the world’s most challenging diseases.

Overview

Felix Milman	**Goals & Business Need**
Brian Sauerborn	**Solution Overview**
Eimantas Macys	**Implementation Detail**
Felix Milman	**Results**

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Goals & Business Needs

Goals & Business Needs: User Requirements

- **Digital platform** that promotes **interoperability** between benchtop and control layer
- Flexible platform that integrates both common and **uncommon signal types**
- **Scalable infrastructure** that minimizes time to integrate and instance new equipment
- Accessible design that is **easy to install, update, and maintain**

Goals & Business Needs: Operational Flexibility

- An R&D pilot plant requires the ability to adapt process design and process equipment.
- Off-the-shelf control systems may introduce operational, design, and communication constraints:
  - May not be designed for **interoperability** with other control systems, may use legacy communication protocols.
  - Limitations on system design, types of equipment that can be used, amount of external I/O that can be connected.
  - Frequent version upgrades making the existing lab system **outdated and unsupported** by vendor.

Goal: Achieve monitoring and control capability for all pilot plant equipment, while minimizing cable clutter

Common Bioprocess Unit Operations & OEM Systems

Unit Operation
Cell Culture
ATF
TFF
NFF

Goals & Business Needs: Modular Pilot Plant

- An R&D pilot plant's automation infrastructure should be modular to **manage many processes and equipment.**
  - A pilot plant has several concurrent programs running, each with **different process and equipment requirements**.
  - Based on program requirements, a local automation team needs to **adapt configuration quickly** without hindering plant capacity.
- With diverse sets of equipment and control requirements across the plant, 1:1 connections are difficult to manage and instance.
  - When the process or equipment changes at one station, that change must be **instanced to all stations** in the plant.

Goal: Design a solution that allows a local automation team to quickly instance and configure equipment and control across the plant from a single platform.

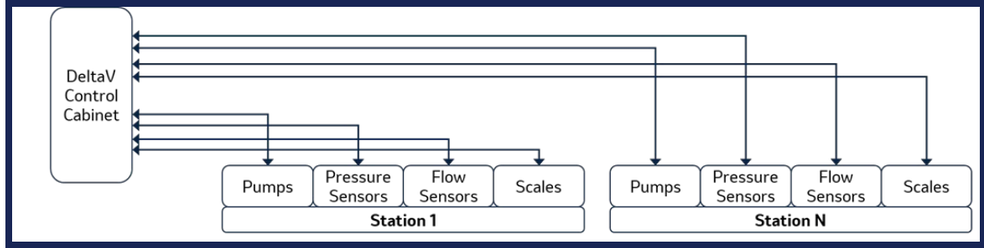

Figure. Example of a possible lab signal diagram. In this example, it is difficult to manage existing connections and scale out to new stations.

Goals & Business Needs: Digitizing offline data

- **Offline equipment** is often used in cases where an off-the-shelf system does not fit process or communication requirements.
  - This data is **not integrated into the control system**, cannot be monitored remotely, and is difficult to historize and analyze.
- Offline equipment often constitutes a significant percentage of all pilot and lab scale equipment within a plant.
  - These processes rely on manual data transfer, where **process data is not recorded in or monitored in real-time.**
  - Time-to-market is a critical variable in the pharmaceutical development. **Minimizing data transfer and processing time through digital transformation** is a critical business driver.

Goal: Digitize as much offline lab data as possible, minimizing or eliminating manual data-transfer workflows.

Common Offline Equipment

Equipment
Pumps
Probes
Sensors
Balances

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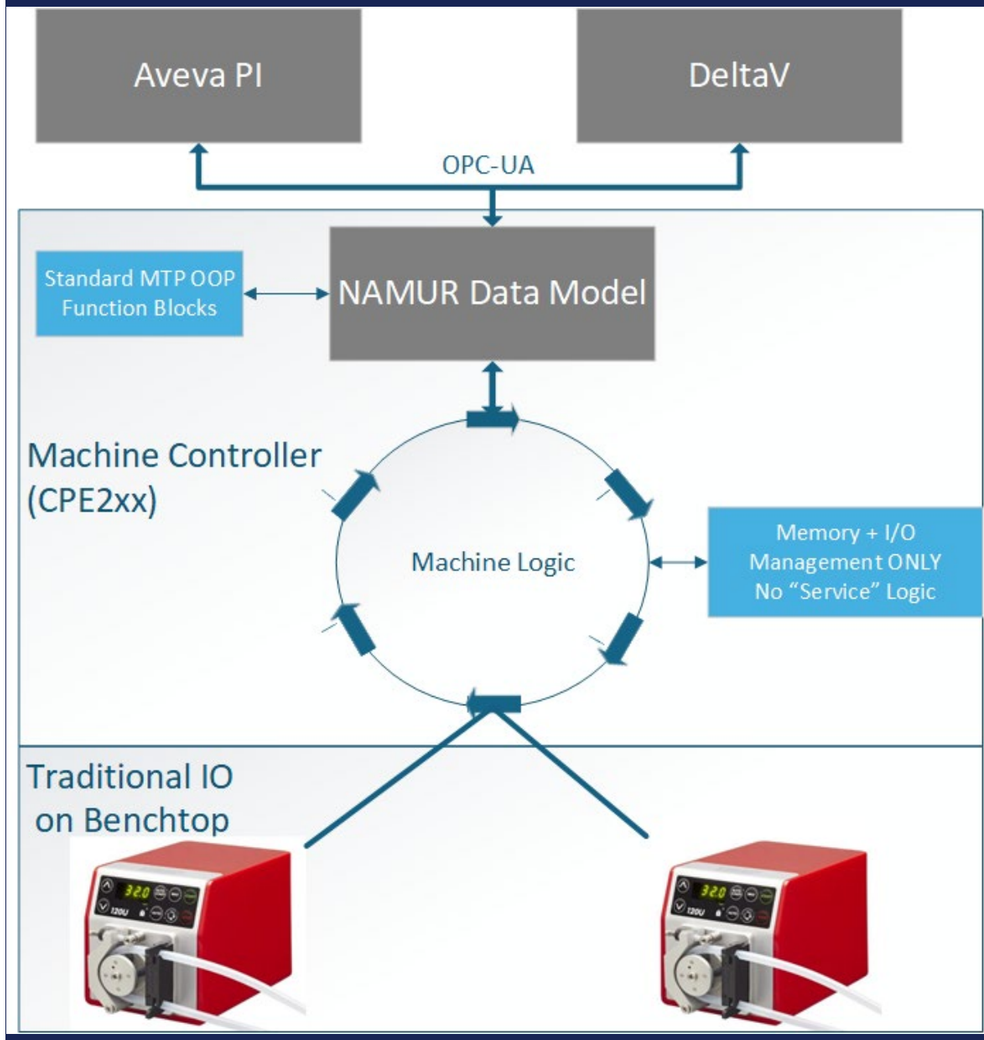
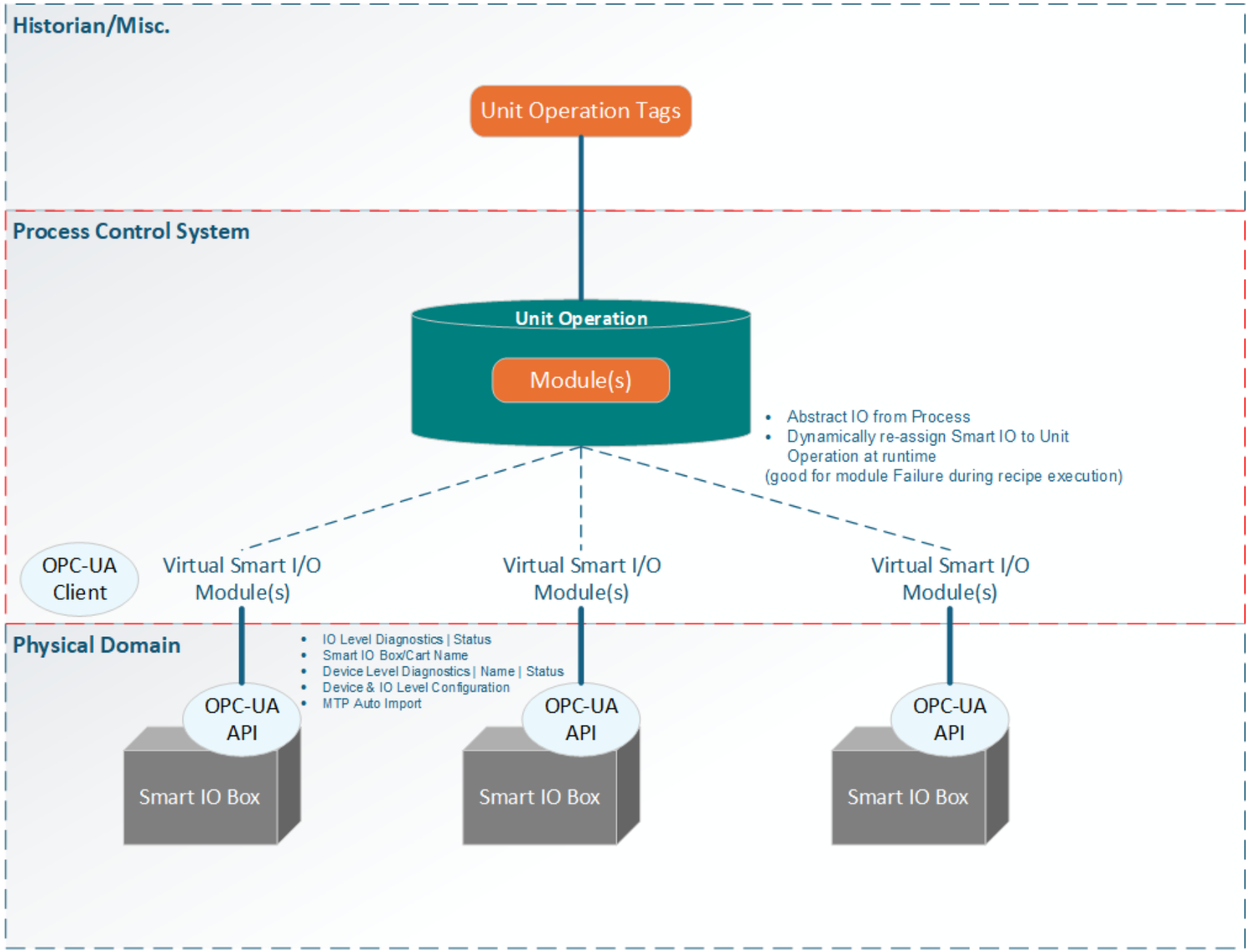
Solution Overview

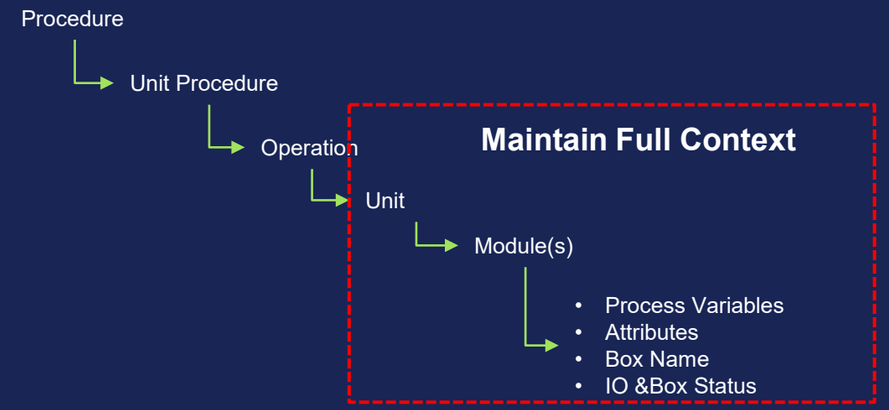
Solution Overview: Guiding Principles of Development

- Compatibility (with POL and most I/O types)
  - Must be robust enough to accommodate nearly any type of I/O
- Compactness (decrease clutter and noise)
  - Must be compact enough to be tucked away and allow for a clean benchtop, but
  - Must be capable enough to accommodate a high density of I/O
- Expandability/Scalability (adapting to technical development environments in lab spaces)
  - Ease of digitization must be at the forefront of decision making



Solution Overview: Scaled-Out

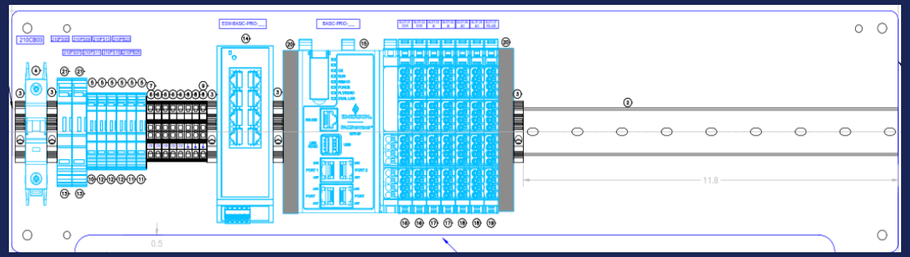




Implementation Detail

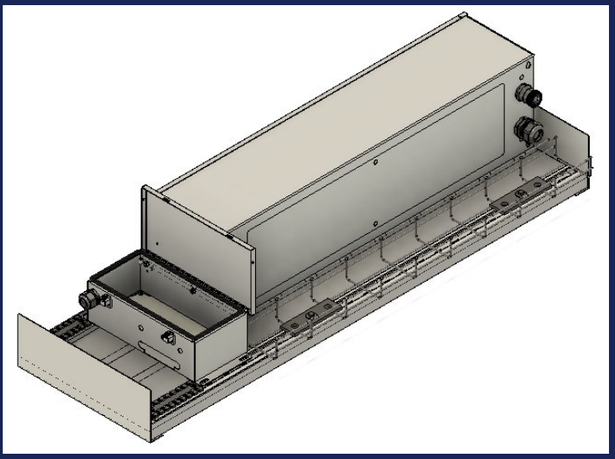
Technology (Hardware)

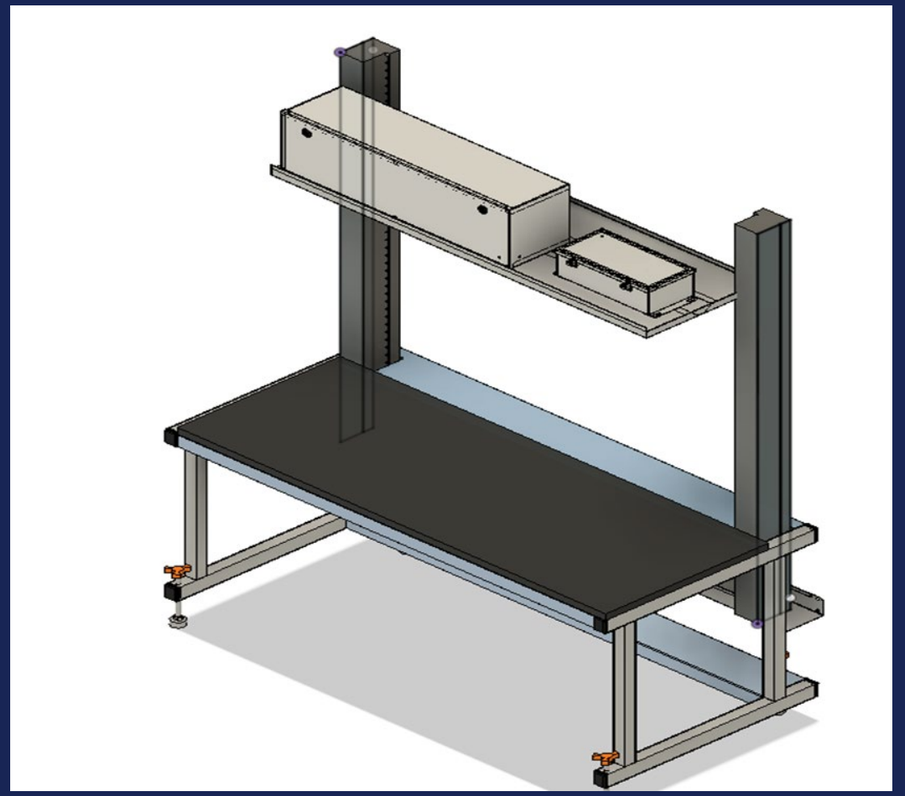
- Emerson RSTi-EP Series Controllers and Slice I/O
  - Contextualizes I/O into the universal MTP Standard
- Network Address Translator
  - Private-side Network for final control elements
- M12 Bulkheads for all signals, power output, ethernet
  - Industry-standard way for swift, robust, and reliable connection
- Expandability due to design



Technology (Hardware) cont.

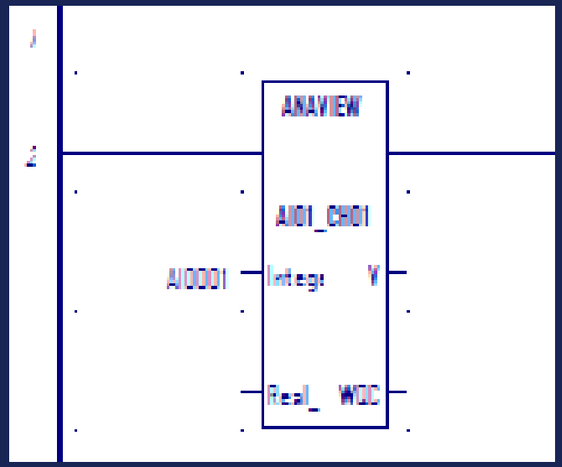
- Small-footprint
  - standard size: 9”H, 30”W, 8”D
- Single-wire to Distributed Control System
  - Reduced clutter
  - Mobility
- Reliability and Troubleshooting
  - all mechanical/electrical troubleshooting is done between the equipment and SmartBox

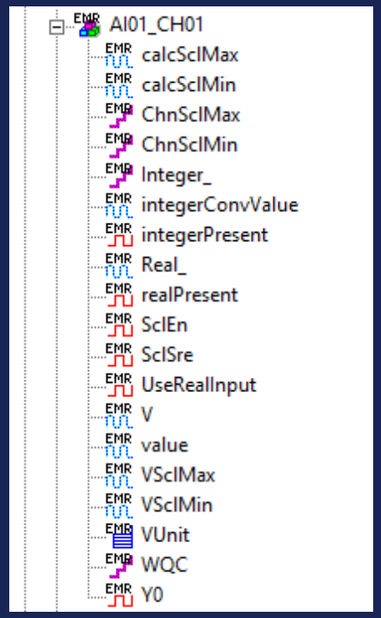




NAMUR/MTP

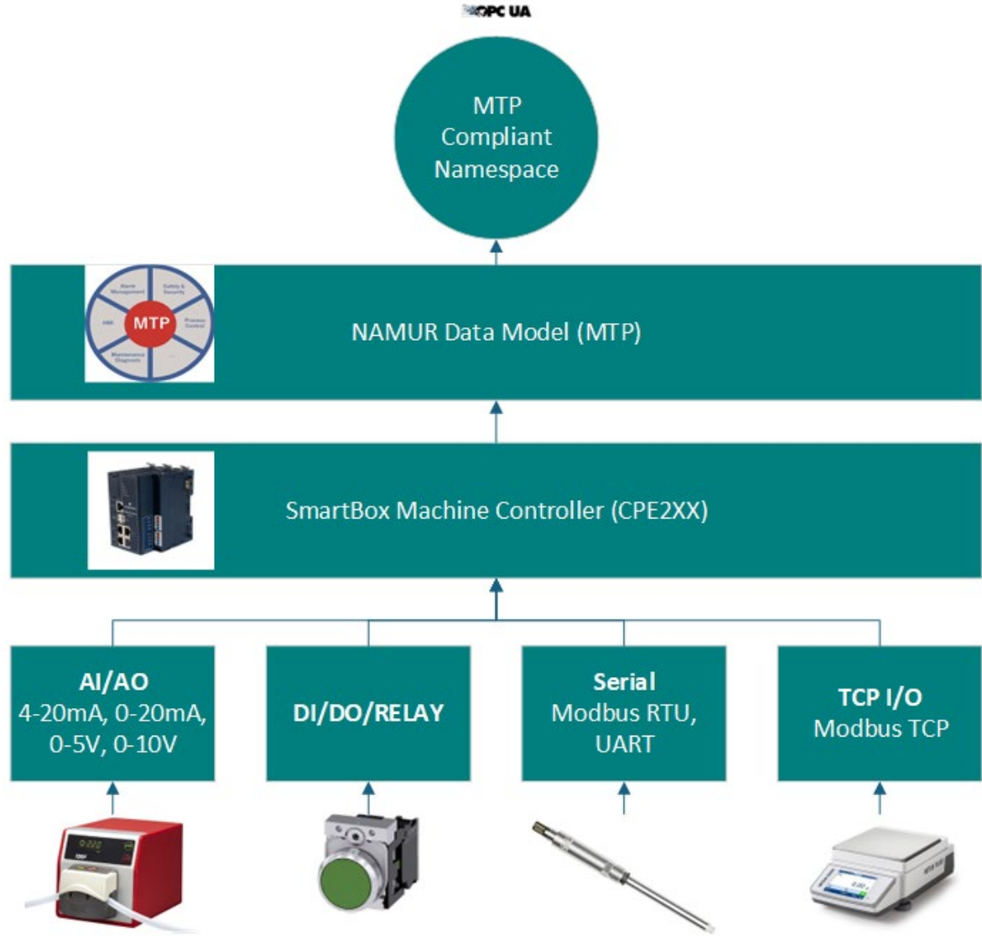
- NAMUR Data Model Generated via MTP Function Blocks within PLC Logic (Process Equipment Assembly)
  - auto-contextualizes data points into a universal standard
  - Like User Defined Type
- All MTP Objects are exposed via an OPC-UA Server with up to 8 Clients
  - connections to a Process Orchestration Layer (DCS, PCS), historians, and data brokers
- Seamless MTP Import to Process Orchestration Layer
  - auto import utilities for MTP are supported by most Distributed Control Systems





Compatibility (Final Control)

- Traditional I/O
  - Analogue Input/Output
  - Digital Input/Output
  - Relay (Dry/Wet Contact)
- Serial I/O
  - Modbus RTU
  - UART
- TCP I/O
  - Modbus TCP



Results

Results:
A new digital foundation

- **+2500 new 1:1 equipment connections added, including 30,000** I/O points, significantly expanding automation capabilities.
  - Extensive and unprecedented amount of new 1:1 instrument – DeltaV connections made possible through the Smart IO project.
- Smart IO digitization enables a more **ergonomic** lab space.
  - Smart IO consolidates and eliminates tangled wiring, cabling, and bulky HMI's – decluttering and allowing for efficient use of lab space.
- Create a unified Smart IO platform applicable across scales.
  - Off-the-shelf systems are typically designed for specific batch sizes. Smart IO generalizes the integration so that one format can be applied to both benchtop and large-scale processes in an R&D facility
- Smart IO lays a groundwork for **digital transformation.**
  - Integrating hundreds of offline instruments accomplishes an important step towards digital transformation, allowing us to explore new platforms for automating data transfer, alarming, and batch reporting.

Transformation Snapshot
Benchtop-scale Perfusion TFF

Comparison	Previous state	Current State
TFF Control	• **Recirculation**: flow sensor to pump	• **Recirculation**: flow sensor to pump • **Permeate**: flow sensor to pump • **General**: any sensor to any pump
External I/O availability	• 4x Analog • 4x Serial RS-232	• +8x Analog • +2x Serial RS-232 • +4x ModBus RS-485 • +3x Ethernet
Equipment types	• **TFF** I/O must be compatible with OEM control systems • **Bioreactor** I/O limited to RS-232 & analog	• Any equipment to support TFF or Bioreactor operations • Addition of PAT for control and process monitoring
User Experience	• In-person TFF and bioreactor control • Remote monitoring via 3rd party software integration	• In-person process control via DeltaV • Remote monitoring and control via DeltaV

Goals & Business Needs: User Requirements

- [x] **Digital platform** that promotes **interoperability** between benchtop and control layer
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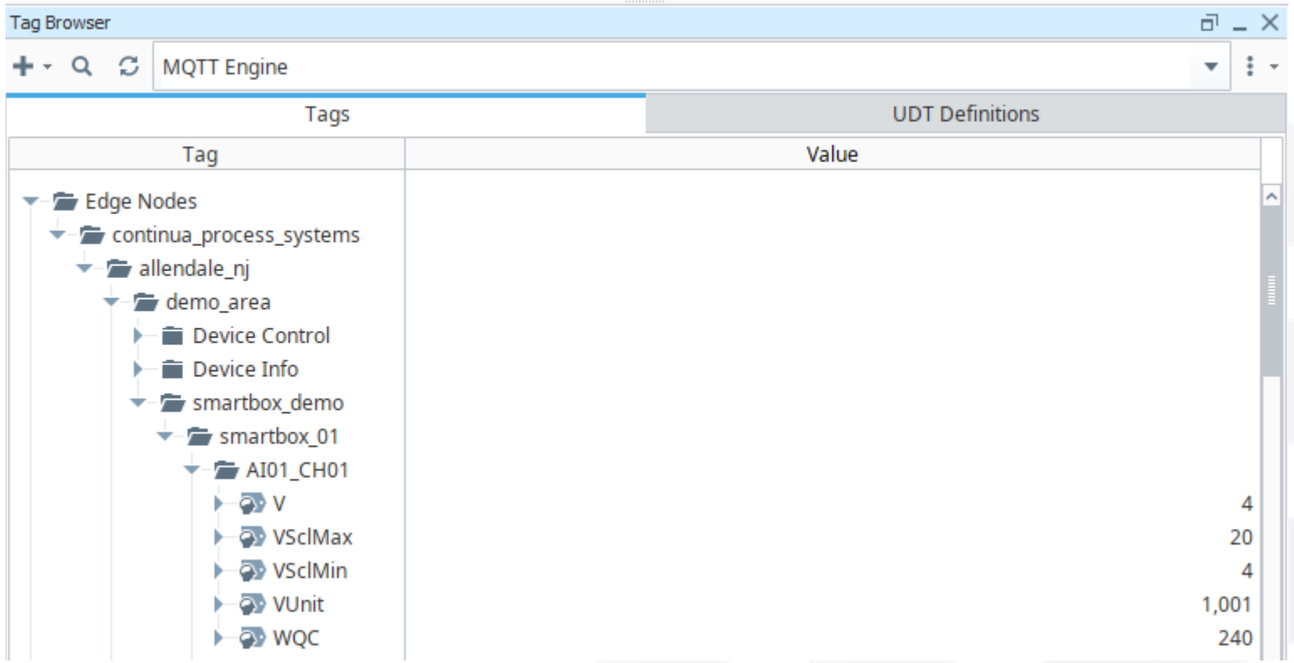
Future State

Future Goal: Self Aware Integration

- With the foundation set, the realization of a future where a box of I/O is plugged in and is plug-and-play capable of being digitized and integrated into any platform is closer than ever
- We aim to achieve a future where this box is plugged into a network and automatically “appear” within OT and IT platforms alike, with the right context.
  - As if the Box was “aware” of its existence with respect to the automation platform living within a network



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Find More Information

https://control-associates.emersonimpactpartners.com/products/control-and-safety-systems/conexion-platform/

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Thank You