



Nyx System Overview



Notices
● The reproduction, transmission or use of this document or its contents is not permitted without express written authority. ● Information and specifications in this document are subject to change without notice. ● While information in this document is well edited and checked, mistake or omission may exist. Please don't hesitate to contact SUPCON if you have any question about this document. ● Please contact SUPCON via email "SMS@supcon.com" if you have any questions.

Trademarks
Trademarks SUPCON, PLANTMATE, AI-POET, InPlant, dOps, ESP-iSYS, Webfield, ics, MultiF, SupField, and APC are all registered by SUPCON Technology Co., Ltd., which owns the properties of all above trademarks. It is strictly prohibited to use any of the above trademarks or marks without a written permission from SUPCON Company. We reserve the right to take legal action against any individuals or companies using trademarks or marks above illegally.

Symbol Definition	
	WARNING: Indicates information that a potentially hazardous situation which, if not avoided, could result in serious injury or death.
	RISK OF ELECTRICAL SHOCK: Indicates information that Potential shock hazard where HAZARDOUS LIVE voltages greater than 30V RMS, 42.4V peak, or 60V DC may be accessible.
	ESD HAZARD: Indicates information that Danger of an electro-static discharge to which equipment may be sensitive. Observe precautions for handling electrostatic sensitive devices
	ATTENTION: Identifies information that requires special consideration.
	TIP: Identifies advice or hints for the user.

Table of Contents

1 Overview	1
1.1 Features	1
1.1.1 Software Defined	1
1.1.2 Total Digitalized	1
1.1.3 Cloud-based	1
1.2 System Structure	1
1.3 Functions	2
1.4 Technical Specifications	4
1.5 Certifications	4
2 Control Data Center	5
2.1 Control Data Center Hardware	5
2.2 NyxOS	5
2.3 Nyx Designer	6
2.3.1 Plant Models	6
2.3.2 Control Strategies	6
2.3.3 Hardware Configuration	6
2.3.4 AI-PID	7
2.3.5 AI Assist Programming	8
2.4 GPU Powered Control Engine	8
2.5 Monitoring Services	8
3 Intelligent Field	10
3.1 SmartEIO Remote I/O Enclosure	10
3.2 APL Field Junction Box	11

1 Overview

SUPCON has unveiled the technical architecture of the next-generation Universal Control System (UCS), which overcomes the limitations of traditional distributed control systems that were constrained by their rigid hierarchy, purpose-built hardware, and restricted computing power. UCS redefines control systems by introducing a software-defined, total-digitalized, and cloud-native architecture.

"Nyx" is the first UCS developed by SUPCON. It offers several standout advantages: a cloud-based real-time operating system - NyxOS, cloud-native control as a service (CAAS), deterministic 10G industrial optical networks, an Ethernet APL-connected field, and AI-Inside capabilities.

1.1 Features

1.1.1 Software Defined

Software is decoupled from hardware, enabling high availability and on-demand control services.

1.1.2 Total Digitalized

Field connectivity is optimized through Ethernet-APL technology, specifically engineered for intrinsically safe applications.

Intelligent field dramatically saves more than 90% on cables and footprint, while boosting communication rate by more than 100 times.

Effortlessly gain access to field data with digitalized field assets.

1.1.3 Cloud-based

Cloud-based NyxOS unlocks unparalleled flexibility, easy scalability, allowing you to access resources and services on demand, while ensuring high availability and robust fault tolerance to keep your operations running smoothly.

1.2 System Structure

Nyx is composed of a Control Data Center, deterministic optical Ethernet, and an intelligent field ecosystem.

- Control Data Center: A micro data center that provides computing power for the system.
- Intelligent Field Ecosystem: An ecosystem facilitated by APL junction boxes or SmartEIO field enclosures, ensuring connectivity and easy data access.
- Deterministic Optical Ethernet: Integrates various networks—such as SOnet for information, SCnet for control, and IOnet for I/Os—ensuring seamless plant-wide data transmission and enhanced operational efficiency.

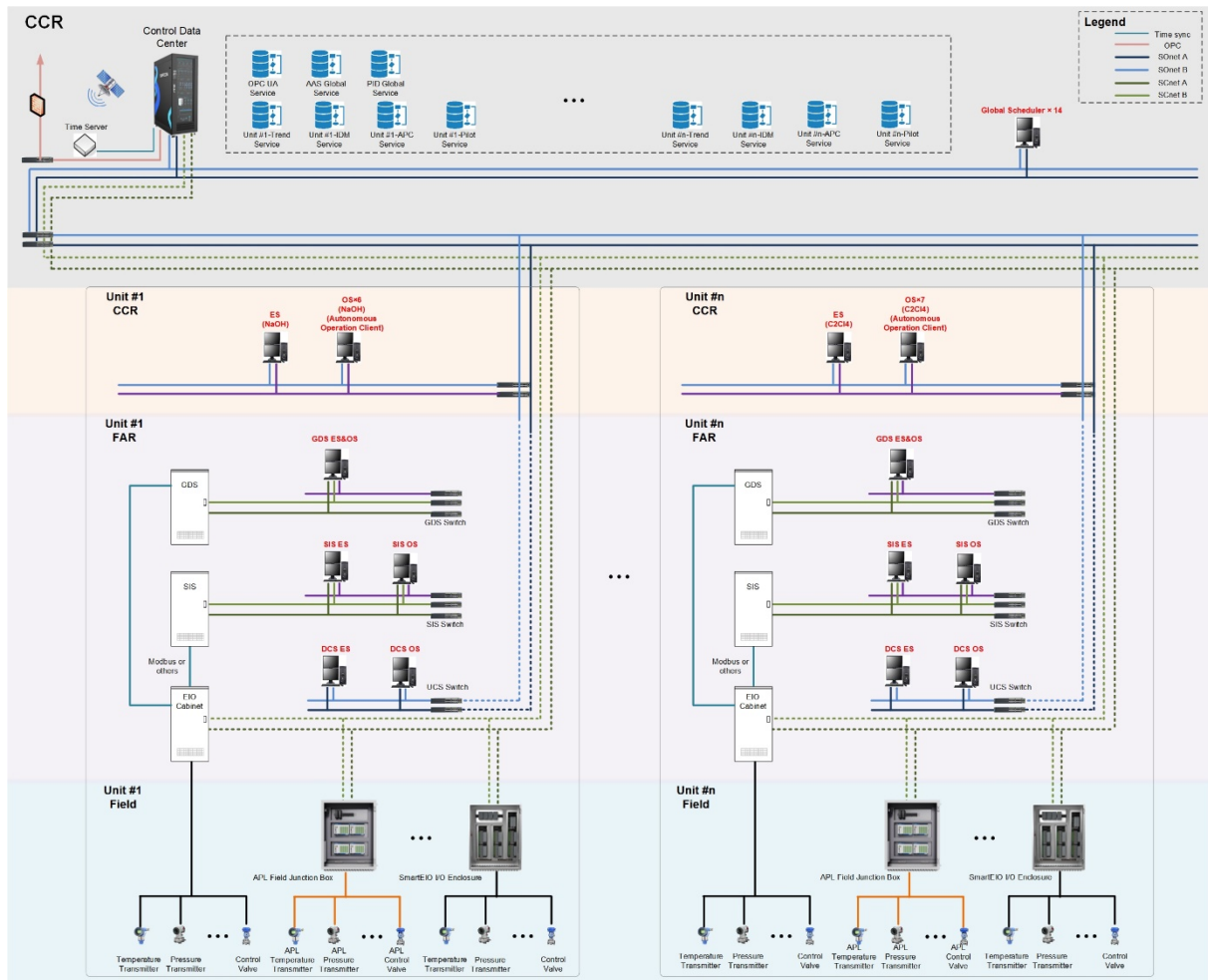


Figure 1.1 Example of system network structure

1.3 Functions

The Nyx Control Data Center introduces a cohesive hierarchical structure, where the control level executes, the service level coordinates and monitors, and the application level strategizes and optimizes.

- Control level: real-time control modules programmed with advanced programming languages;
- Service level: monitoring services, alarms and events (A&E), historical data, and other operational services;
- Application level: asset management, global diagnostics, AI analytics, and other applications.

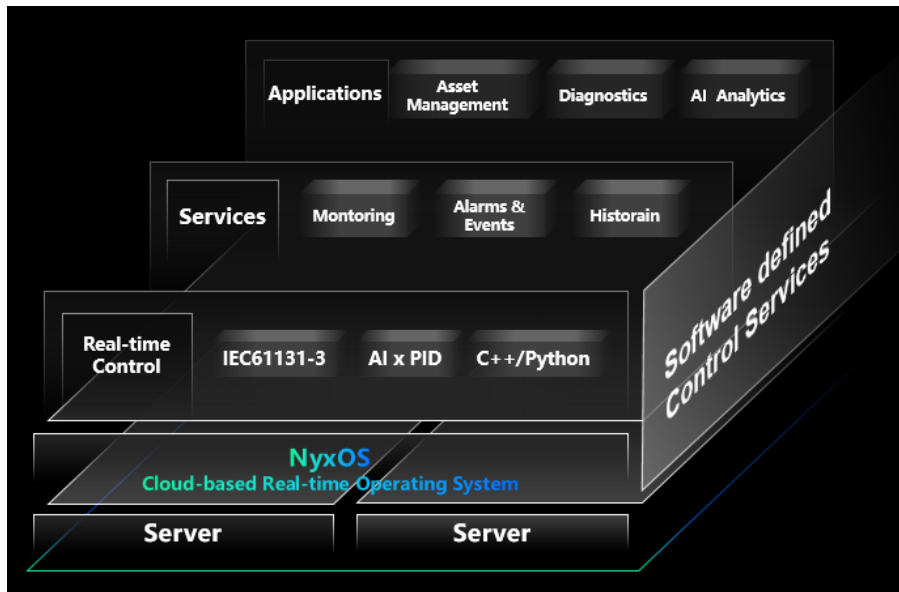


Figure 1.2 System functional architecture

This table lists the core control applications in the Nyx Control Data Center.

Table 1.1 Core control applications

Application	Functions
Monitoring Services	Offers state-of-art functionalities including process display, alarms and events, trend query, report management, data open interfaces, and multi-project support. Loaded with standardized controls such as radar charts, bar charts, and profile charts, the intuitive HMI delivers a more streamlined and smooth experience.
Nyx Designer	Provides configuration functionalities covering system settings, plant models, HMI resources, cooperative configuration settings, and more.
GPU-Powered Control Engine	GPU computing empowers AI control services. The control engine supports traditional languages (FBD, LD, ST, SFC), and advanced languages like C++ and Python.
AI-PID	Advanced AI-PID function generates control strategies, controls output based on process states, and continuously performs PID tuning with its reinforced learning capability backed up by process data and models trained with historian.
AI Assist Programming	Analyze design documents using LLM (large language models), and code with the AI assistant.

1.4 Technical Specifications

Table 1.2 Key specifications

Item	Specification
System scale	Up to 2 million IO points.
Intelligent control services	Up to 100 pairs of controllers (control as a service). Multi-state redundancy is supported.
Monitoring Services	Up to 1,000 operation stations.
Nyx Designer	Up to 250 engineer stations. Concurrent configuration by up to 32 users is provided.
System Redundancy	Fully redundant design, covering power source, computing power, and system network.
Intrinsic Security	Intelligent control service (controller) supports trusted boot and security protection.
Environmental Adaptability	Complies with EMC level 3 and can operate between 0 to 50 °C.
Basic Programming Languages	FBD, LD, SFC, ST (IEC61131-3)
Advanced Programming Languages	C++, Python, GPU-powered AI control

1.5 Certifications

Nyx products comply with the following standards:

- Low Voltage Directive 2014/35/EU
- Electromagnetic Compatibility Directive 2014/30/EU
- G3 (ANSI/ISA 71.04-2013) approved by TÜV
- Achilles Level 2 by Wurldtech's Achilles

The system has been certified to meet the following Chinese National Standards.

- GB/T 3836.1-2021 Explosive atmospheres - Part 1: Equipment - general requirements
- GB/T 3836.3-2021 Explosive atmospheres - Part 3: Equipment protection by increased safety "e"
- GB/T 3836.4-2021 Explosive atmospheres - Part 4: Equipment protection by intrinsic safety "i"
- GB/T 3836.8-2021 Explosive atmospheres - Part 8: Equipment protection by type of protection "n"
- GB/T 3836.20-2010 Explosive atmospheres - Part 20: Equipment with equipment protection level (EPL) Ga
- GB/T 3836.22-2017 Explosive atmospheres - Part 22: Protection of equipment and transmission system using optical radiation

2 Control Data Center

Nyx Control Data Center is the core of the Nyx system. Running on the dedicated operating system - NyxOS, the Control Data Center provides users with configuration, control, monitoring, and other services.

- Control Services: Complete the real-time control tasks of the control system, including loop control, logical operations, and execution of advanced algorithms.
- Configuration: Responsible for the configuration of plant models, control strategies, HMI resources, and user permissions.
- Monitoring Services: Mainly provide monitoring and operation services, for production monitoring and intelligent supervision.

2.1 Control Data Center Hardware

The Control Data Center integrates servers, optical core switches, OLT modules, cooling units, UPS, fire protection, power distribution, cabling, and lighting in one place. The plug-and-play hardware greatly shortens the project period.



Figure 2.1 Control Data Center hardware

2.2 NyxOS

The cloud-based real-time operating system - NyxOS is the basis of building a reliable Control Data Center. NyxOS is embedded with an orchestration engine for automating deployment, scaling, and management of containerized control services and resources.

NyxOS is characterized by its self-healing capabilities and high availability. The high reliability

and rapid self-healing of real-time control tasks is guaranteed through high-priority real-time modules. The control cycle is as fast as 1 ms, with the real-time schedule delay being less than 100 μ s. Composed of the kernel layer, configuration management, and service management, NyxOS provides a robust platform for deploying and managing containerized control services within a cloud environment. The configuration layer of NyxOS includes configuration management for master and clusters, as well as settings for response mechanisms in the event of errors.

Applications running on the NyxOS include, but are not limited to, control services, monitoring services, historical data services, alarms and events services.

2.3 Nyx Designer

Nyx Designer is a software platform that allows for building plant models, control strategies, and system structure.

2.3.1 Plant Models

Plant model is the structured model of a plant, covering the process flow, equipment layout, and control strategies.

In a Nyx Designer, users first build up plant models, and then configure control strategies, equipment parameters, and HMI configurations for various plant nodes.

2.3.2 Control Strategies

Users create control loops or control programs for the Nyx system in the Designer, supporting IEC 61131-3 languages such as Function Block Diagram (FBD), Ladder Diagram (LD), and Structured Text (ST), as well as C++ and Python for designing control strategies. Nyx Designer also provides a rich library of function blocks, supporting features like online debugging simulation of control programs.

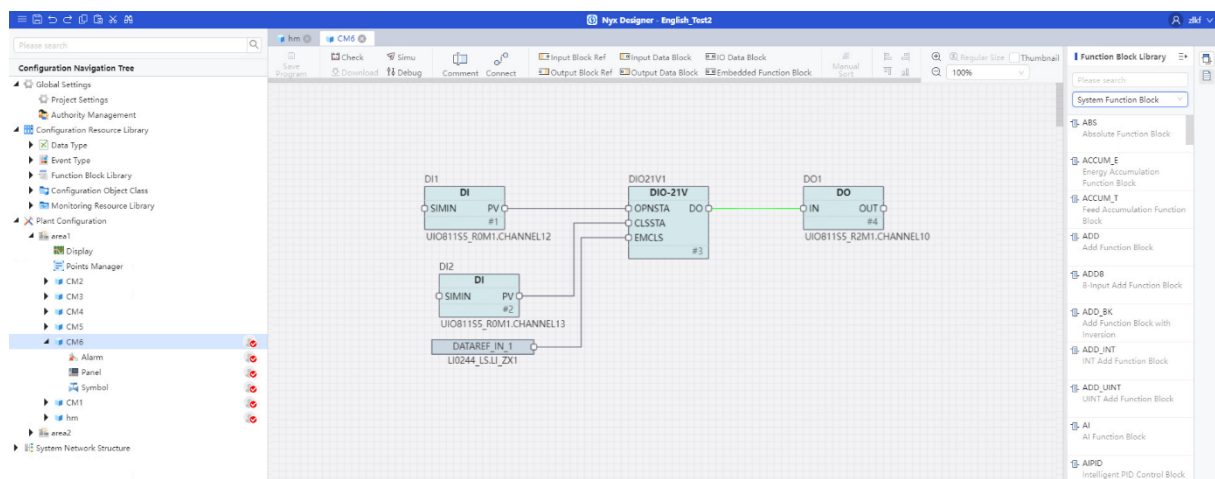


Figure 2.2 Control strategy configuration example

2.3.3 Hardware Configuration

Hardware configuration refers to the setup of hardware such as controllers, communication modules, APL devices, and SmartEIO modules. Nyx provides features such as hardware

parameter settings, hardware configuration scanning and uploading, and hardware debugging.

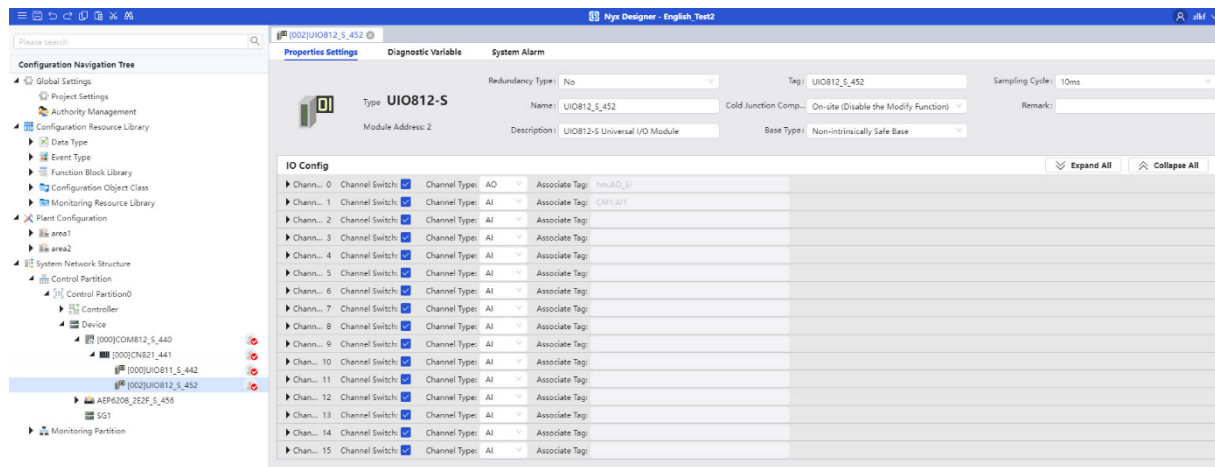


Figure 2.3 Hardware configuration example

2.3.4 AI-PID

Advanced AI-PID function generates control strategies, controls output based on process states, and continuously performs PID tuning with its reinforced learning capability backed up by process data and models trained with historian. Nyx introduces a reward and evaluation module to dynamically control the loop performance, thereby enhancing the tuning efficiency.

AI-based PID control delivers more steady and smooth control for various states and situations.

The large amount of control data generated through traditional PID is used for modeling to create initial control strategies. During the real-time control phase, the reward and evaluation module assesses the control result and feeds back to the reinforced learning based intelligent control agent. The agent then judges the quality of the control parameters based on the feedback mechanism and updates the training database. This completes the parameter iteration of the control strategy, delivering better control performance.

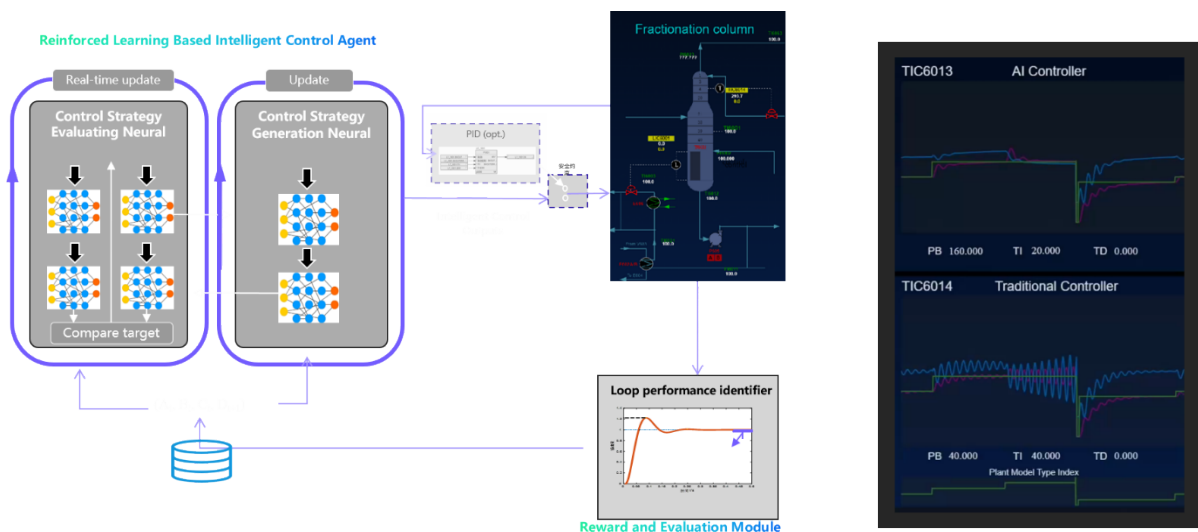


Figure 2.4 AI-PID principle

Nyx System Overview

user interaction.

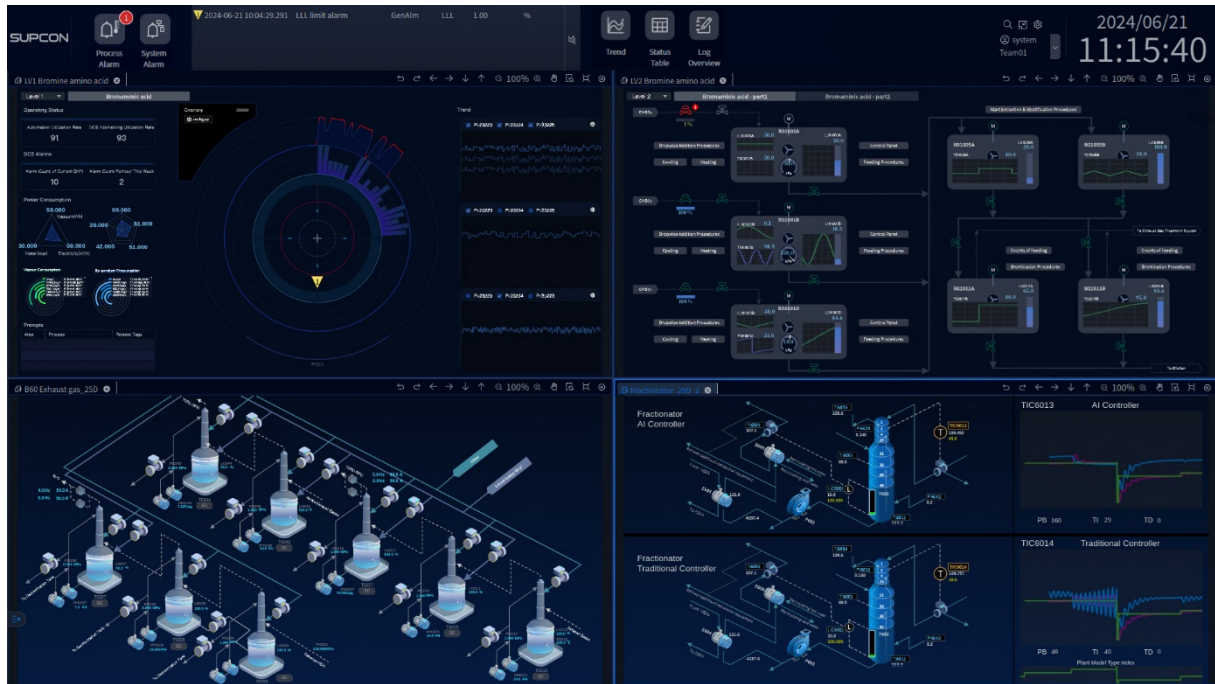


Figure 2.6 Nyx HMI

3 Intelligent Field

Two types of 96-point junction box are available in the Nyx intelligent field - APL field junction box and SmartEIO remote I/O enclosure.

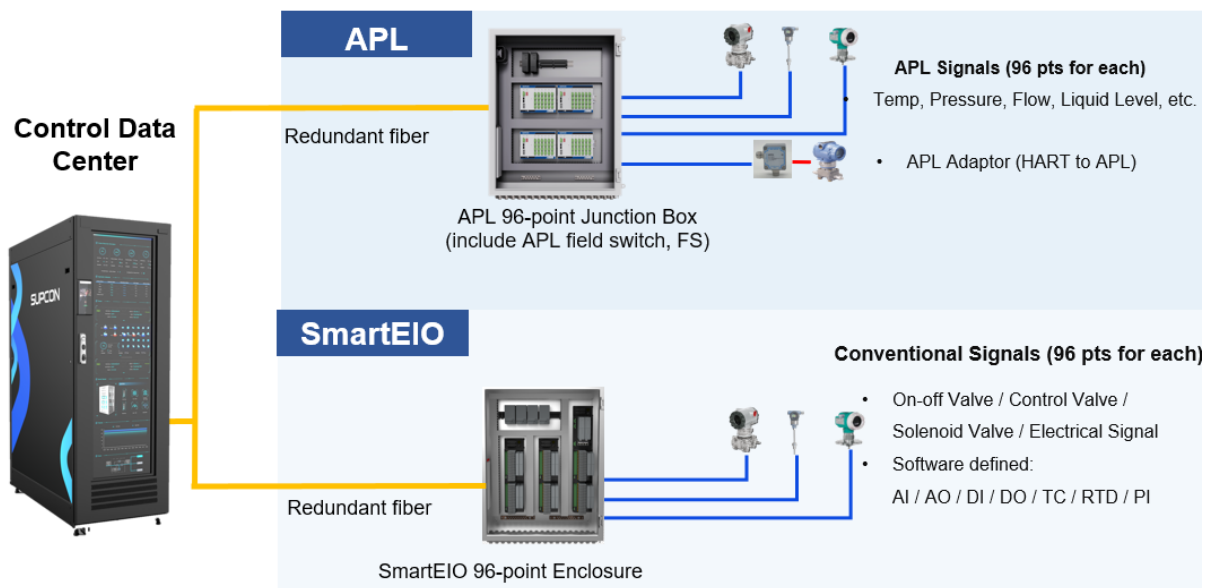


Figure 3.1 Intelligent field

3.1 SmartEIO Remote I/O Enclosure

SmartEIO is a universal I/O module that defines channel types through software and signal adapters, flexibly adapting to field instruments while also meeting the explosion-proof requirements. SmartEIO can be deployed both in the remote field or control room. For remote deployment, the ATEX- and IECEx-certified explosion-proof SmartEIO remote I/O enclosure can be situated directly within Zone 2 and interface with IS or explosion-proof signals from field zones, each accommodating up to 96 signal points.

Universal I/O module offers 16 isolated channels. Each channel can collect and output different signals with the aid of its dedicated signal adapter. The supported signals are AI, AO, DI (SOE), DO, RTD, TC, PI, NAMUR, AI/AO-HART, and more. When using with channel-to-channel isolated signal adapters, the module provides isolation between channels. If working with IS adapters, it allows for connectivity with field IS equipment. SmartEIO module supports 1:1 redundant configuration.

Its fully redundant design covers communication, power supply, and I/O modules, featuring high reliability and availability. The SmartEIO universal I/O module comes with built-in temperature and humidity detection chips, allowing environmental data from within the enclosure to be uploaded to monitoring software via the communication bus. SmartEIO is engineered to minimize the risks inherent in opening enclosures within hazardous areas, consequently cutting down on

maintenance expenses for customers.

3.2 APL Field Junction Box

APL Field Junction Box connects industrial Ethernet (RJ45, SFP, PON) and APL network. APL (Advanced Physical Layer) products include APL universal I/O, pressure transmitters, switches, FF couplers. The products are designed based on 802.3cg10BASE-T1L, a two-wire Ethernet-based standard, which defines a new two-wire, intrinsically safe physical layer for power supply and transmission integration, and is suitable for process automation applications with higher requirements. It features functions such as 10 Mbps broadband transmission, 1000 m long-distance deployment, anti-explosion and anti-interference, high reliability and stability.

The APL Field Switch AEF6224-2E2F-S, referred to simply as "AEF6224," is the core device in the APL Field Junction Box. AEF6224 features 2 redundant Ethernet ports and 2 redundant PON ports for connections for the PON networks; it also provides 24 APL Spur ports for communication with APL instruments. AEF6224 is powered by a 24V DC redundant power supply and can provide power to each APL Spur port. The AEF6224 supports access to the Nyx Control Data Center with a PON switch.

The industrial-level AEF6224 is suitable for deployment in harsh environments and hazardous Zone 2.



SUPCON Technology Co., Ltd.

Address: No.309 Liuhe Road, Binjiang District, Hangzhou, 310053, P.R.China

Website: <http://global.supcon.com>