



FDT Unified Environment for Industrial Device Management and IT/OT Data Transport

SECURE CONFIGURATION OF DEVICE DATA
AND COMMUNICATION FOR CONTROL SYSTEM
DESIGN, OPERATION, AND MAINTENANCE



Integrating Tomorrow's Technology

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Abstract

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The Industrial Internet of Things (IIoT), Industry 4.0 and the convergence of Information Technology (IT) and Operational Technology (OT) is dramatically impacting the industrial product solution ecosystem. Everything from a simple sensor to an entire control system, including communication and integration standards, is driving a new way of thinking about the industrial computing environment.

To date, IT and OT have been in scope for different data domain experts in the manufacturing world. While IT and OT have different needs, the increasing need to overlap these territories will deliver a unified approach to data-driven smart manufacturing practices. These innovations will revive manufacturing's critical infrastructure with new service-oriented architectures uniting communications for both the business and operating workforce.

FDT Group's new FDT (3.0) Unified Environment (UE), with its FDT Server and built-in OPC UA Server solution, enables robust IT/OT integration and provides a secure gateway to network/device data and health information. The standard offers OPC UA Client/Server-authenticated access to operating data, and its utilization of a Publish-Subscribe environment allows for real-time data exchange.



Introduction

The Industrial Internet of Things (IIoT) ushered in a new era of smart manufacturing where control systems and advanced applications monitor intelligent sensors, utilize mobile devices, and create smart systems. The IIoT is redrawing the lines between traditional Operational Technology (OT) and Information Technology (IT) systems.

IT is focused on the use of computers, storage, networking, infrastructure and production processes to create, process, store, secure and exchange data. OT includes hardware and software that detects or causes a change through the direct monitoring and/or control of intelligent sensors and actuators.

For manufacturers, understanding the wider integration and flow of data between the OT layer and IT applications provides the opportunity to use real-time data to make faster, better business decisions.



Operational Landscape

More than a decade after the introduction of the term Industry 4.0, industrial companies are on varied paths and timeframes to become more information-intensive with a connected environment of people, processes, and production systems. Leaders want to take advantage of emerging capabilities to improve efficiency, visibility, and collaboration on the factory floor — technologies that use data insights to create more intelligence, automation and optimization across equipment, processes, facilities, and people.

Industry is demanding integrated IT and OT systems to make better business decisions. Yet that convergence has proven challenging for many manufacturers that traditionally have treated IT and OT as isolated technologies and engineer, maintain and use each for different purposes.

Evolving standards-based technologies are revolutionizing a manufacturer's ability to use integrated IT/OT data to design and employ models that form the basis for increasing overall efficiency, quality, and agility.

Unifying OT and IT systems and practices in a converged system architecture means businesses can eliminate inefficiencies and barriers to interoperability, reduce design time, increase operational effectiveness, and accelerate innovation.



IT/OT Convergence

The advent of the IIoT has enabled the ability to connect intelligent devices, systems, and applications to create a flexible and interoperable operating environment. Legacy Machine-to-Machine (M2M) systems — traditionally consisting of a single type of device or sensor and a single, pre-determined connectivity method — can now be replaced with more powerful, continually evolving IIoT solutions. Proprietary operational control systems are giving way to new, open solutions based on standard IT platforms and protocols.

A central consideration and challenge in achieving operational interoperability is protocol independence. Depending on the specific application, manufacturing operators may encounter numerous disparate automation protocols that must be connected to achieve operational or optimization goals. IIoT and Industry 4.0 applications require the connection of many devices and systems to collect and share the vast amount of high-quality data across OT and IT platforms.

Manufacturers looking for IT/OT convergence will benefit from a centralized platform that receives data from connected devices in real-time. This will allow the connected system to fully support monitoring and control of processes from a standardized interface. Converging IT/OT data in one Industry 4.0-friendly platform supports visualization of the factory as a whole so decision-makers can get productivity status updates consistently and on time.



Standards Collaborate

Leveraging industry standards that support IT/OT convergence will seamlessly enable sensor-to-cloud integration and IT/OT information exchange making the adoption of Industry 4.0 a reality.

The two open, end user driven standards that can enable IT/OT convergence and intelligent manufacturing excellence for process and discrete applications are:

OPC Foundation – OPC Unified Architecture (UA)

OPC UA is the interoperability standard for secure and reliable data transport and configuration in the industrial automation space and other industries for enterprise level business operations. With the introduction of service-oriented architectures (SOA) in manufacturing systems came new challenges in security and data modeling. The OPC Foundation developed the OPC UA specifications (companion specifications and information models) to define the interface between Clients and Servers, as well as Servers and Servers, including access to real-time data, monitoring of alarms and events, access to historical data and other applications. These new features address marketplace needs and at the same time provide a feature-rich technology open-platform architecture that is future-proof, scalable and extensible.

FDT Group – FDT (3.0) Unified Environment (UE)

FDT UE is the interoperability standard allowing secure and reliable configuration and data visualization for industrial automation systems and connected devices. The Unified Environment works independently of communication protocol, vendor, device/device type/representation, or information model supporting all aspects of a control system's lifecycle - designing, operating, and maintaining control system assets. Due to industry needs for IT/OT convergence and open platforms enabling sensor to cloud integration, configuration, and visualization, FDT leverages OPC UA, creating an FDT Server converging IT/OT data transport, enabling centralized configuration, and extending monitoring and optimization sensor to cloud, bringing innovative SOA architectures/environments to the market.



The OPC Foundation supports FDT Group in the development of an information model for the FDT Server, which is based on information provided by DTMs via collaborative companion specifications and information models creating a FDT Unified Environment ecosystem. This collaboration enables a single solution for open, sensor-to-cloud configuration and communication for the industrial, process, discrete and hybrid manufacturing industries connecting automation systems, asset management systems, and other plant and enterprise systems and applications.

This work holds significant value for industrial end users, allowing them to take the best-of-breed application and device data supported by FDT UE that leverage the OPC UA information modeling and corresponding services for complete application-to-device integration.

The solution offers:

- Consistent and meaningful device data access for enterprise level applications
- Common device information model
- Availability of full functionality of FDT concepts to OPC UA clients (e.g., device health monitoring, device diagnosis and device parameterization)
- Foundation for long-term applicability of combined technologies
- Clear data and service interface definitions
- Platform to enforce the capabilities of modern digital automation devices to satisfy customer needs
- Adaptability for future device functionality



FDT (3.0) Unified Environment and Ecosystem

The new FDT UE was developed based on user feedback. It provides a platform-independent, single-server, cloud-based, data-centric, service-oriented environment offering the freedom to use collaborative innovation to support new and existing manufacturing infrastructure through a smart, connected ecosystem of integrated machines and devices.

The FDT United Environment is focused on IT/OT convergence and comprehensive operational management through OPC UA Services, FDT Web Services, and a single configuration interface for comprehensive control. The FDT UE offers seamless data exchange, client access and remote data management and is an important and strategic development towards supporting centralized and comprehensive IT/OT lifecycle management and configuration via the internet.

The harmonization of the FDT/OPC architectures is uniting technologies, solutions, and people for today's infrastructure and tomorrow's intelligent enterprise.

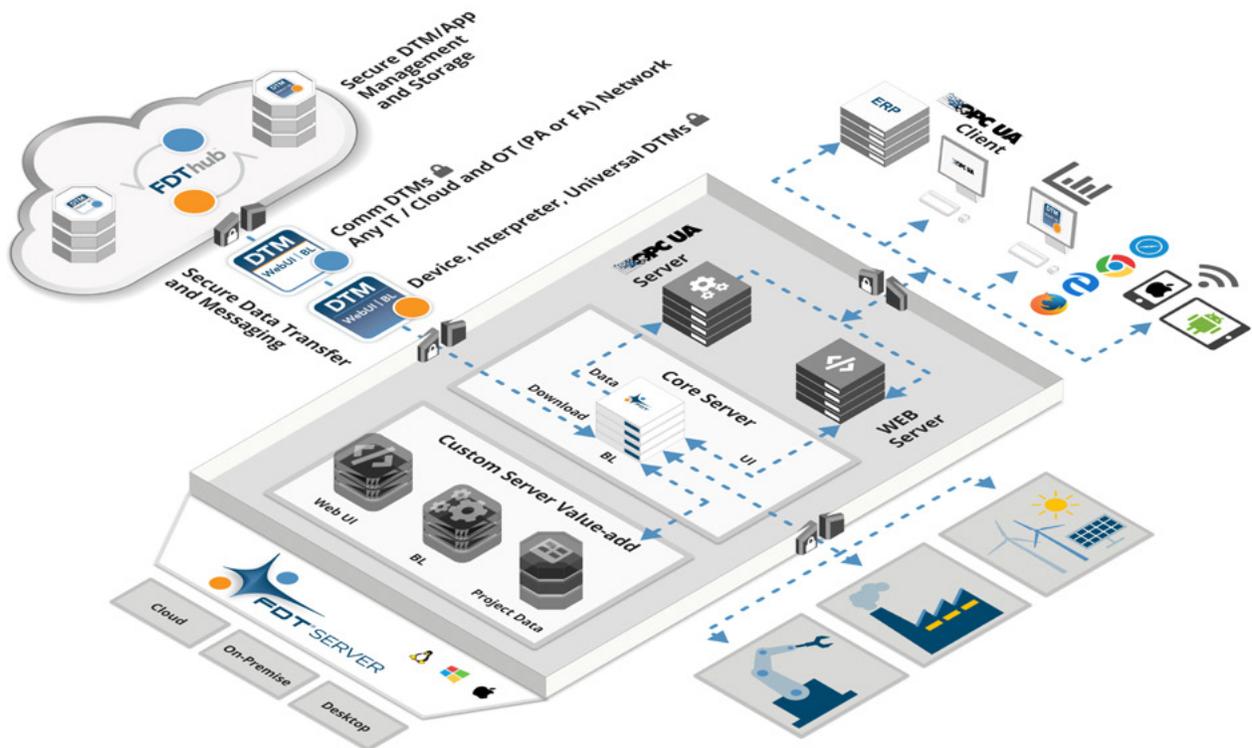
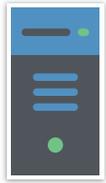


Figure: FDT UE Service-Oriented Server Architecture



The FDT UE ecosystem is comprised of two main software components:

A key feature of the new FDT UE ecosystem is that FDT Servers and FDT DTMs automatically provide full OPC UA support without additional effort or coding, optimizing advanced device diagnostics, configuration, and remote asset management.



- **FDT Server** – An FDT Server provides the runtime environment and application context for secure sensor to cloud device DTM integration, data exchange and visualization. The server is the pivotal IIoT data hub that sits at the core of any application fully deployable in the cloud, on premise or at the edge — empowering the intelligent enterprise. It incorporates service-oriented interfaces for business and operational monitoring and control/configuration. The natively integrated OPC UA Server (inclusive of the built-in Universal Device Information Model for DTMs), according to the companion specification “OPC UA for Devices,” supports IT/OT data convergence and enterprise access via any authenticated OPC UA client or application. The web server enables modern device management and maintenance via any authenticated FDT client by browser or mobile device. The core server allows for centralized control/configuration of the topology. The rich control features enable sensor-to-cloud industrial communication independent of protocol or vendor device supporting smart manufacturing practices.



- **FDT DTM** – A DTM provides the business logic and user interfaces for device and network specific data and functionality and plugs into the FDT Server allowing OPC and FDT client access. DTMs unlock universal device and network integration and support flexible deployment — including a multi-tiered topology or a flattened Ethernet-based architecture. The DTM portfolio includes field devices and communication infrastructure devices including gateways and protocol adapters. DTMs provide feature-rich parameter profiles/functions and data necessary for lifecycle management — simulation, planning, commissioning, operation, and diagnosis of the respective device/network.

FDT Unified Environment (UE) Benefits

Platform Independent - Compatible with choice of operating system — MacOS, Linux and Windows

Flexible Deployment - Cloud, On-premise, Desktop



FDT Server Embedded Components:

- OPC UA Server – Organizes integrated IT/OT Data, transport and communications for highly reliable client/server infrastructures and real-time deterministic control with Pub Sub environments. The built-in Universal Device Information Model for all devices, networks, and industries (Process, Hybrid and Factory) is supported along with other information models including PA-DIM.
- Web Server – Mobilizes the industrial workforce with modern device management using browsers and mobile devices
- FDT Core Server – Enables comprehensive topology and device configuration
- *FDThub* – Provides a single device repository for secure online/offline DTM/App management and storage

Built-in Security

- End to End Communication Trust
- User Authentication
- Roles and Role Management
- Audit Logging
- Certificate Management Infrastructure

Interoperability – Plug and Play

- Developed based on open standards for sensor to cloud integration
- Supports all process and factory protocols and mixed network topologies
- Compatible with any device, device type, device representation, or device information model

Centralized Configuration

- Topology configuration and control for all DTMs supporting any mixture of networks and devices
- Incorporates DTM (Web) user interfaces and business logic
- Stores, instantiates, and executes DTMs, which are always kept up to date via the *FDThub* DTM repository.

Visualization – Monitoring and Optimization (M&O)

- **OPC Client Access and Services for 4.0 Advanced Analytics** – ERP, MES, Historians, Central HMI, Digital Twin (Production Network Simulation), Reliability Center, Scheduling, Custom Services and Apps
- **FDT Client Access and Services for 4.0 Device Management and Configuration** – Advanced Process Control via DCS, PLC, Asset and Alarm Management Applications, Dispatching, Mobile Devices, Custom Services and Apps

Adaptable – Future Proof

- Protects investment in legacy technology
- Integrating tomorrow's technology



Secure Data Visualization Access

The FDT UE features a uniform data mapping approach to information visualization serving semantic data models for Industry 4.0 applications. The FDT Server leverages the FDT OPC UA Universal Device Information Model (for all devices, networks, and industries), defining all the compatible interfaces supporting all device and network parameter profiles as outlined in the Companion Specification harmonizing IT/OT data access for any OPC UA Client. It is the only protocol-agnostic, server-level, universal device information model for both process and discrete manufacturing applications, empowering next-generation, open automation communication.

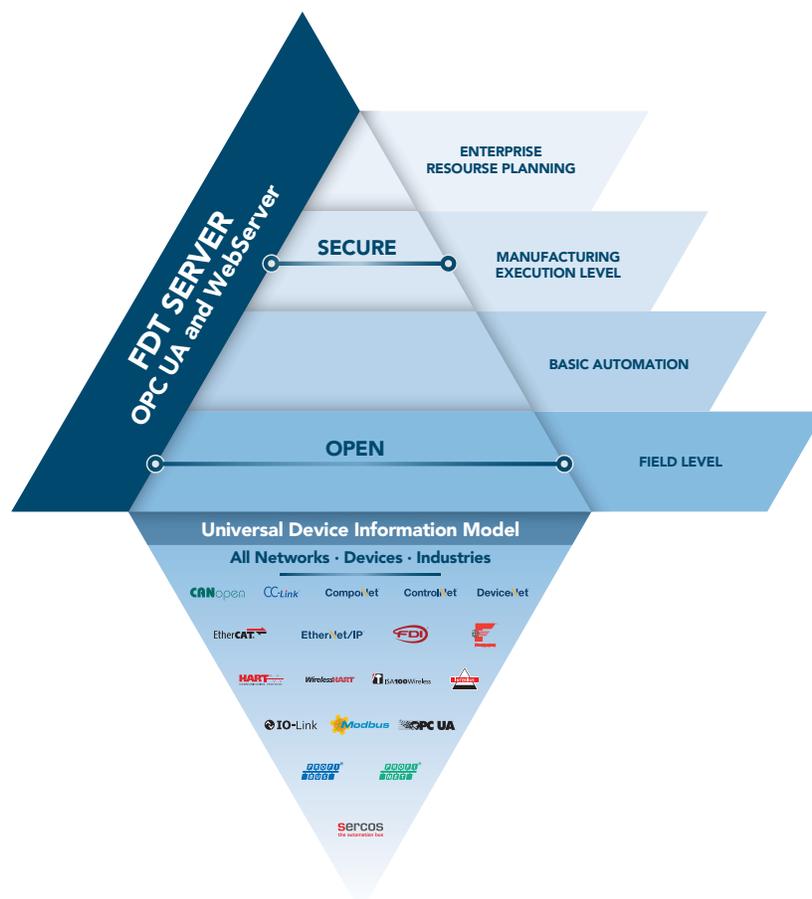


Figure: FDT OPC UA Universal Device Information Model provides data mapping for enterprise access

The FDT Server optimizes secure visualization through defined interfaces meeting important monitoring and optimization use cases driven by the automation industry allowing for field to enterprise connectivity, communication, and services without the need for protocol-specific handling. It is possible to have one server, supporting all devices from different vendors, which provides all device-related information and services.



DTMs can provide semantic information for all parameter values. It is possible to provide an eCL@ss description for a device type to support detailed engineering, or to link maintenance documents for a device instance to support lifecycle management.

The DTM can serve as hub to all device-related information.

Authenticated OPC UA clients or applications can seamlessly access FDT DTM on/offline business logic and defined OPC UA interfaces for process device data (including device and network information and metadata), protocol support files, diagnostic information, and device health status (NE107). The OPC for FDT companion specification strengthens the FDT Server architecture with a universal approach to DTM data mapping.

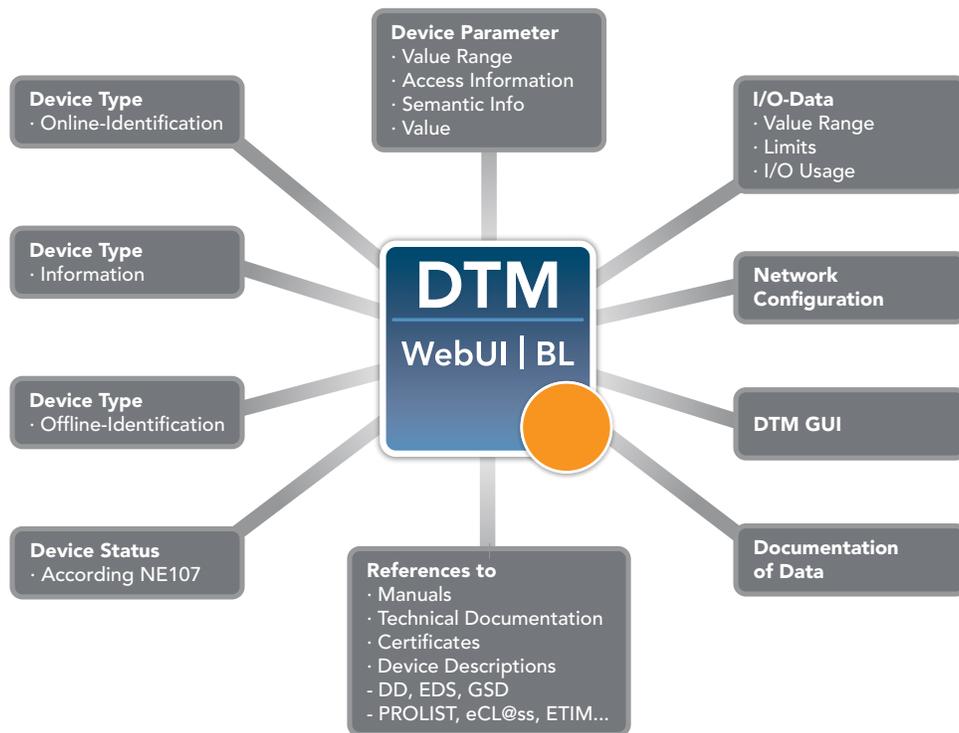


Figure: FDT DTMs contain all device type data and interfaces exposed via the Universal Device Information Model

Standard OPC UA browsing techniques are used to expose DTM device data types, interfaces, business logic and core parameter profiles allowing authorized OPC UA clients read/write access to the FDT Server via the Universal Device Information Model to browse, collect, and act on the data as needed.

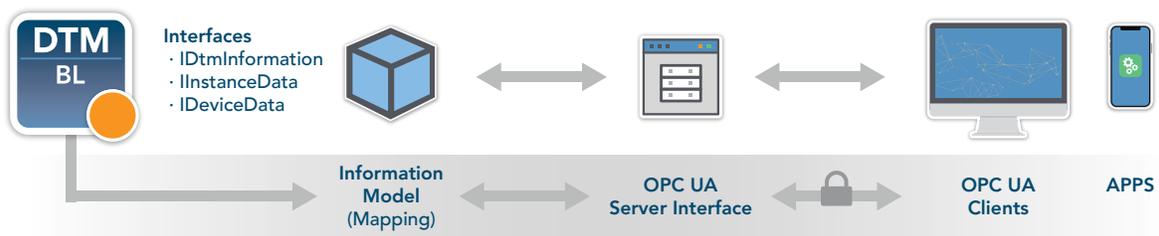


Figure: FDT DTMs expose device-specific data via information mapping to authenticated OPC UA Clients and customized apps.



With the FDT UE, end users benefit from utmost interoperability, freely mixing and matching any device with any device information model, from any vendor, and communicate on any network while the FDT Server transparently unifies device information and pushes the data to the enterprise for any OPC UA Client in real-time.

Client-Server (Highly Reliable)

The FDT Server supports a Client-Server-based request-response communication mechanism between the OPC UA Client and Publisher. This approach makes the full range of information model access available via services and, in doing so, follows the design paradigm of SOA, in which a service provider receives requests, processes them, and sends the results back with the response.

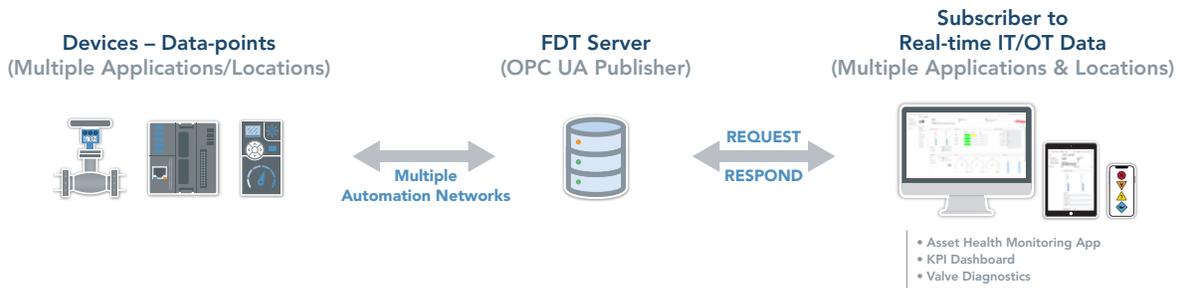


Figure: FDT Server Client-Server Communication Model

Pub-Sub (Deterministic)

The FDT Server supports the Publish-Subscribe (Pub-Sub) communication environment for efficient, real-time data monitoring and exchange. The Pub-Sub methodology eliminates the burden of request-response communication, and multiple clients can subscribe and receive notifications. The FDT Server automatically notifies all the subscribed clients when the specified information has changed according to predefined parameters. The Pub Sub approach is essential for secure multicasting, one-to-many publishing, machine-to-machine communication, dynamic network relations, and several additional scenarios.

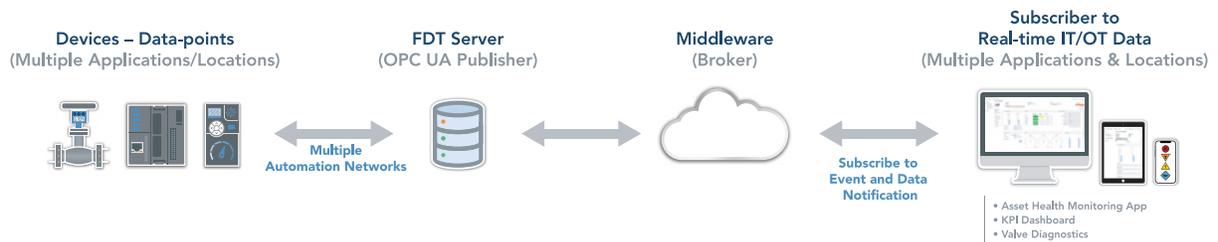


Figure: FDT Server Pub-Sub Communication Model



Empowering End Users with Harmonized Automation

FDT UE brings harmonization and operational excellence supporting open automation initiatives. With the FDT Unified Environment, end users benefit from the ability to pick best in breed products for their applications with plug and play ability through a SOA that empowers distributed communication across the enterprise. Best of all, end users will realize shorter design time, improved operations, and proactive maintenance of their equipment and manufacturing processes.

FDT UE was designed and developed based on industry-driven collaborative feedback providing:

- **Open Interoperable Data-Centric IIoT Environments** – Enabling a future-proof FDT Server-based SOA distributed architecture that is operating system, network, device, and vendor independent
- **Secure, Scalable, and Adaptable Platforms** – Providing embedded configurable end-to-end trusted interoperability supporting cloud, edge, on-premises, or enterprise-wide agile architectures
- **Comprehensive Control and Configuration** – Empowering a natively integrated OPC UA server for IT/OT data harmonization and IT/enterprise access along with a web server empowering OT/operations, mobility, and web-browser-based access supporting modern asset manufacturing practices
- **Standardized Universal Device Integration** – Delivering a customizable unified data collaborative/interoperable engineering platform (offline and online) and ecosystem for maintenance, reliability, and operations



Conclusion

Unification through industry collaborations is key to harmonize technologies, solutions, and people for today's infrastructure and tomorrow's intelligent enterprise. Both FDT Group and OPC Foundation are open interoperability standards unique in their foundations for the process and factory automation worlds. The FDT UE merging the IT/OT data domains needed for smart manufacturing strengthens the core of any automation system with a universal approach to industrial device management and data transport opening the door to innovative service-oriented business model solutions reviving manufacturing's critical infrastructure.

These collaborative efforts are a win-win industry-wide and bring the industry closer together improving the ROI for everyone. The business and operational advantages wrapped around emerging technologies are providing a secure gateway to open automation innovation in this evolving digital world.





Empowering the Intelligent Enterprise



For More Information

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