Leveraging a Standardized IIoT Ecosystem to Empower Innovative Business Models

HOW FDT 3.0 OPTIMIZES NEXT GENERATION AUTOMATION SOLUTIONS

Integrating Tomorrow's Technology

Contents

Abstract

Digitalization offers automation companies a great opportunity to successfully shape the future. However, this process also brings many challenges such as remote real-time data access, end-to-end security, and multi-vendor equipment integration and interoperability.[1]

Industrial stakeholders want to do more with operational and business data, including accurate interpretation of the information and taking correct actions to ensure a desired outcome.

FDT Group's new, forward-looking standard, FDT® 3.0 (also known as FITS™), will accelerate the evolutionary journey of the organization and its technology into the Fourth Industrial Revolution. Developed from industry-driven feedback, and providing a bridge between the currently installed FDT-based and next generation solutions, the updated standard enables an FDT-based Industrial Internet of Things (IIoT) ecosystem to meet the demands for digitalization and Industry 4.0 applications.

FDT Group's open, data-centric integration approach is the key enabler for the new era of industrial automation. FDT is the only standard of its kind providing an open architecture with standardized, built-in mobility and remote access; native OPC Unified Architecture (UA) integration; robust security; and platform independence, while still leaving the manufacturer in control of customizing their product or solution.

At the core of FDT's digital transformation pathway is the introduction of the new FDT Server. Empowering a robust, platform-independent environment, the FDT Server natively integrates an OPC UA Server for enterprise-wide data access and a web server mobilizing remote operations. This innovative solution transforms asset management practices and business system integration for both the automation supplier and end user communities in the process, hybrid and discrete manufacturing markets.

The FDT IIoT architecture works with any major web browser—and requires no changes to installed devices, the programmable logic control (PLC) or distributed control system (DCS) to access real-time plant floor data. The architecture is secure by design with air-gapped support for those who don't allow Internet control system access.

While seizing emerging business opportunities can be difficult for control system and device suppliers, FDT Group has delivered a modernized development environment simplifying the establishment of innovative business models supporting cross-platform FDT IIoT solutions. Suppliers new to FDT or upgrading an existing product line will benefit from the advancements that empower next generation FDT solutions. This includes an open, secure, fully standardized, and data-centric integration ecosystem connecting legacy investments with cloud, on-premise, edge, and enterprise access.

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Introduction

Throughout industrial automation, the increased pace of technology development and global competition amongst control system and device suppliers has made product differentiation more important than ever. Industry stakeholders are demanding open and standardized options for devices, systems and networks, so innovative business strategies need to support these market demands.

Accelerating end user adoption of new technological advances—in broadband networking, cloud-based computing and storage sensor technology—is the impetus for fundamental market shifts and a new wave of digital-driven disruption. Value is migrating away from legacy products that are increasingly commoditized, to the data those products generate and the insights that data drives.[2]

Automation equipment suppliers must meet the demands of manufacturers in the process, hybrid and discrete sectors, who need solutions to mobilize real-time remote operations, especially these days with global health concerns impacting the industrial workforce. The goal is to expand secure access to critical device and network data in order to increase productivity while creating a safer workplace.

Meeting Industry Challenges

In order to achieve long-term success and turn new value chains to their advantage, automation technology and equipment providers must sharpen and re-adjust their sense and understanding of the transformation processes going on in the industry landscape.

How can companies take advantage of the disruptive forces in the new era of automation? Which strategic aims should be considered?[3]

Developing innovative solutions. As the IIoT becomes ubiquitous, automation suppliers must rethink their products and services, or risk being left behind by more nimble, digital-native competitors. They require innovative business strategies designed to seize emerging opportunities. They need to know where their customers' high-value operational data is and how to use this data to help define and execute IIoT and information technology (IT) and operational technology (OT) convergence strategies.

In most plants and factories, there is a need to broadly access data, regardless of what networks or devices are in use. End users seek to employ new technologies that drive meaningful information for optimized business management strategies. This approach not only addresses instruments such as measurement transmitters, but also other plant and factory floor equipment.

Automation stakeholders are keenly concerned about security within their control network infrastructure. The advent of the IIoT has dramatically impacted the cyber threat landscape. The convergence of IT and OT assets has also complicated industrial security. Some organizations in critical process industries have an air-gapped requirement prohibiting users of OT systems from direct or even indirect connection to the Internet. These organizations must find ways to safeguard data access from the enterprise all the way down to the device level.

Meeting market demands. To realize their business goals, a growing number of automation suppliers are pursuing business opportunities utilizing new operating systems to broaden the scope for their product offerings. These enhanced business model strategies must support a standards-based, platform-independent, information-driven approach. Their aim is to help end customers realize the true potential of decentralization, interoperability and integration with a unified view of all data and functions across control applications. They also want to unlock universal device integration with mobility and remote access optimizing processes and connectivity.

Evolving the FDT Standard

FDT Group, founded by a group of automation manufacturers during the Third Industrial Revolution, developed FDT technology as an open, integration standards-based solution to fix interoperability issues for control system and device end users. Today, the standard is widely deployed as the de-facto integration platform providing end users with the freedom to choose systems/devices that best fit their application and seamlessly connect and communicate independent of the chosen vendor or network.[4]

Transforming the core technology. FDT Group's IIoT transformation path to connect and empower the intelligent enterprise has been based on comprehensive, industry-driven feedback. The organization's standards developments have focused on security, performance, ease of use, and investment protection to allow automation suppliers and end users to take advantage of an evolving open integration and information sharing architecture. These features, embedded in suppliers' system and device offerings, are elevating their product line to meet the digital transformation goals of the industrial sector.

FDT Group has long recognized the critical importance of industrial cyber security, and with the help of its team of leading security experts, developed a comprehensive security approach to meet both connected and air-gapped requirements, support virtually any automation architecture, and comply with contemporary security policies in a typical industrial operation providing end-to-end security.

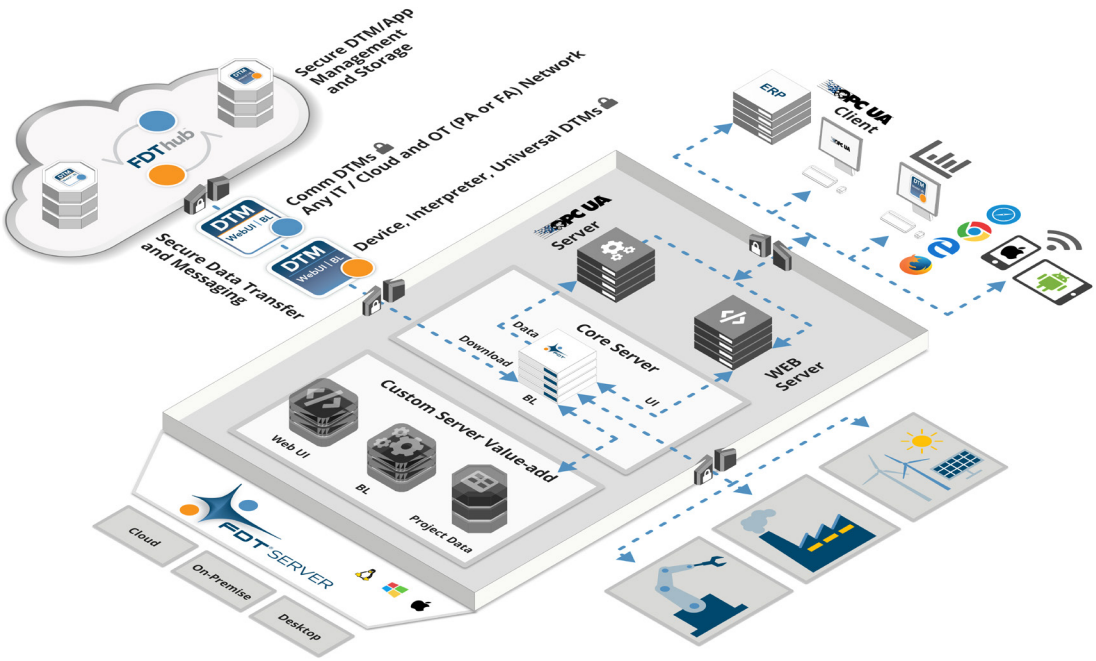


Figure 1: The modernized FDT 3.0 (FITS) architecture.

Over the years, the FDT standard has evolved from a single-user, desktop environment (FDT 1.x) to a distributed, multi-user, client/server approach (FDT 2.x) with OPC UA compatibility for enterprise-wide integration and asset management. The newly launched FDT 3.0 standard builds off its solid foundational base and brings enhancements empowering an FDT Server with embedded OPC UA and Web Servers. The standard supports digital transformation for manufacturers seeking an innovative technology that supports new business models by enabling an open, enterprise-wide, IIoT data-centric integration platform offering built-in security and features to mobilize real-time remote operations.

Designing a flexible FDT IIoT platform. The FDT IIoT Ecosystem consists of an platform agnostic FDT Server and FDT Device Type Managers™ (FDT/DTMs™). Both components are essential to unlocking universal device integration and a data-centric platform to mobilize the industrial workforce with modern and diverse deployment options, including cloud, enterprise, edge, on-premise, and single-user desktop environments.

FDT offers a standardized approach to moving from bilateral to mesh network communication through heterogenous networked architectures. The technology was founded on an IT/OT agnostic approach and integrates any standardized communications network protocol. The core positioning of FDT within an architecture tied to an embedded web server enhances remote access and mobility using standard web browsers while leveraging improved workflow practices for enterprise asset management.

Developing a versatile FDT Server

The FDT Server is a pivotal IIoT hub empowering the intelligent enterprise. This distributive, multi-user server solution employs a web services portal allowing access from authenticated mobile devices or any major browser along with an OPC UA Server for enterprise access to real-time plant floor data. Its rich features ensure any industrial communication protocol or vendor device can be seamlessly integrated as part of smart manufacturing practices.

With FDT 3.0's platform independence, every device vendor or service provider can utilize an edge gateway or cloud instance to push data from multiple facilities to a centralized location for enterprise monitoring and asset management. This capability will be welcomed in Greenfield projects but is equally applicable to Brownfield projects in situation where management is looking to wring out additional availability or wishes to leverage remote access for efficiency improvements.

Natively integrating OPC UA. One question that comes up frequently from end users when discussing the new FDT 3.0 standard is the availability and capability of OPC UA within the architecture. FDT Group's position is that OPC UA is the de-facto enterprise integration standard to push data to the enterprise in support of Industry 4.0 and IIoT initiatives.

For this reason, a native OPC UA Server is built-in to the FDT Server architecture to enable IT/OT integration of real-time data.

The FDT IIoT ecosystem, including both the Server and DTM, was specifically designed to employ OPC UA as a mechanism to ensure secure and versatile data access on an enterprise-wide basis. In the updated FDT 3.0 standard, all device DTMs automatically make their data and health information available through an OPC UA Information Model that works equally with all industrial control networks across factory and process automation. This rich dataset is then exposed through the OPC UA Server built into the FDT Server. This means any OPC UA client that has authenticated access to the server is able to acquire real-time data and health information from any connected device.

Optimizing DTM Visualization. The FDT/DTM within FDT 3.0 is essential for the visualization of smart devices across the enterprise. DTMs contain the business logic software that defines online and offline parameters—device model and bus mapping for each automation device. They encapsulate all device-specific data, functions and business rules. These standardized "drivers" are enabled with a customizable web UI employing HTML 5.0 and JavaScript focused on displaying a graphical representation of parameterization, diagnostic and prognostics across mobile devices and browsers.

FDT 3.0 technology encompasses several essential classes of DTMs:

- **Device DTMs:** Device DTMs are utilized by a host of instrumentation—from simple devices to complex instruments—that employ DTMs for advanced diagnostics and asset management. Device DTMs can support one or a family of common devices such as pressure or temperature transmitters.
- **Universal DTMs:** Universal DTMs (sometimes called Generic DTMs) universally represent all devices with the compliant parameters of a specific protocol.
- **Interpreter DTMs:** Interpreter DTMs interpret other types of device representations, such as Device Descriptions (DDs), Electronic Device Descriptions (EDDs), Field Device Integration (FDI) Device Packages, and IODD to allow configuration and parameter access within an FDT system.
- **Communication DTMs:** Communication DTMs standardize the communication channel to the operations of the mapped IT/OT network protocol.
- **Gateway DTMs:** Gateways DTMs allow communication to transition between the communications paths of different protocols.

The FDT/DTM solution scales from simple to complex devices while automatically enabling compatibility with OPC UA without the need for additional coding. Developers no longer have to map the DTM data model and OPC UA. Now, all device or network Information from the DTM is accessible to an authenticated generic OPC client.

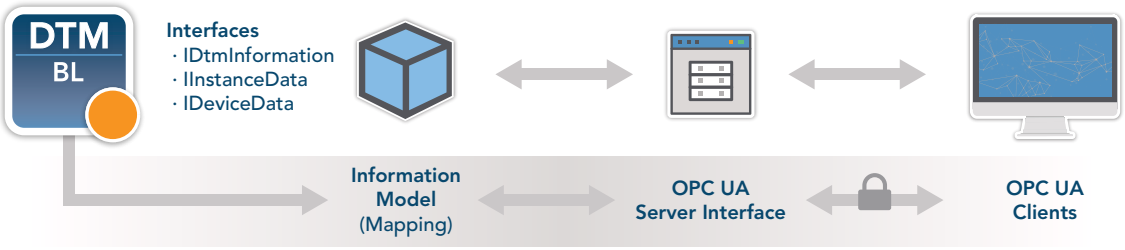
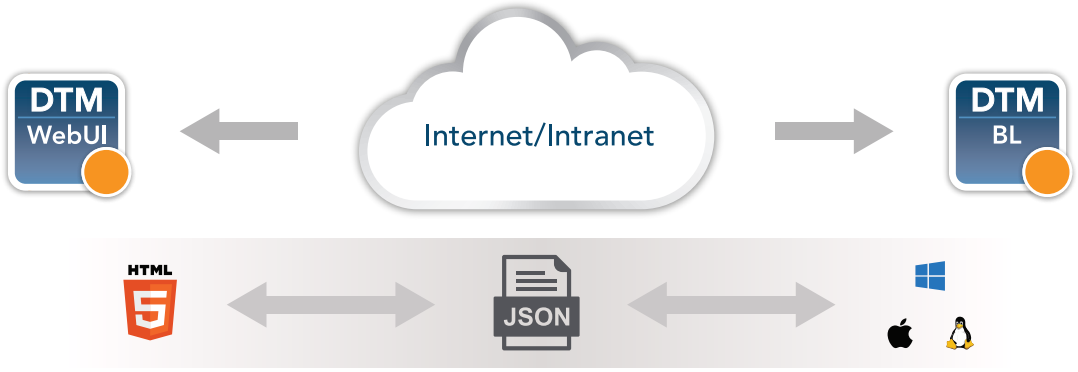


Figure 2. The built-in FDT/OPC UA Information Model.

Since FDT 3.0-based DTMs automatically make device data and health information available via the OPC UA Server embedded in the FDT Server, asset management and enterprise wide data access is now deployable as a cloud service as part of an IIoT initiative. The FITS architecture flattens the automation pyramid so that any application requiring data from devices can retrieve it directly from OPC UA through the DTM without changing incumbent PLC or DCS systems.

One of the most important changes with regards to DTM development with FDT 3.0 involves the user interface. In FDT 1.2, DTM user interfaces employed ActiveX controls, which has become an outdated technology. FDT 2.0 user interfaces were developed with .NET/WPF, which is a more recent technology compared to ActiveX. However, user interfaces with web technologies are currently state-of-the-art for allowing remote and mobile access. The use of HTML 5.0 JavaScript greatly enhances the user's visualization experience while using a more contemporary technology.



Messages between the **DTM WebUI** and the **DTM Business Logic (BL)** are encoded in **JSON** format

Figure 3. The FDT/DTM web user interface.

Improving the availability of DTMs. The new FDT*hub*™ is arguably the most important feature of the FDT 3.0 standard for both the device developer and end user communities. Designed for cloud-based, on-premise or air-gapped deployment, the FDT*hub* is now part of the DTM certification process and eliminates several DTM management headaches. Once a DTM is certified, it is uploaded to the FDT*hub* and made available when the vendor's product is ready for release. This solution supports automatic device discovery and makes it easy to notify end users when there is a new or updated certified DTM available directly from a centralized repository maintained by FDT Group.

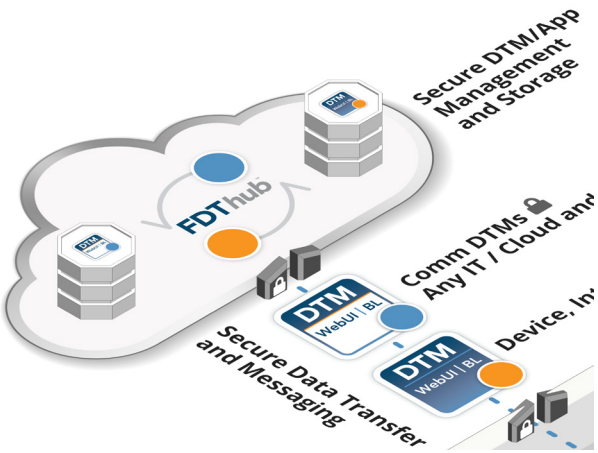


Figure 4. The FDT*hub* eliminates DTM management headaches for devices suppliers and end users.

The FDT*hub* supports development tasks such as planning and engineering of asset management systems. It also helps vendors maintain a consistent DTM export compliance policy across different geographical regions throughout the world.

Enabling mobility strategies. FDT 3.0 Is a key enabler of evolving mobility strategies throughout the industrial sector. With the new generation of DTMs providing platform independence, it is now possible to use mobile applications on different platforms and classes of devices. For example, the developer can write a DTM and then provide the same UI on a laptop, tablet, desktop, or phone—no matter the operating system. Since DTM UIs are now portable and can also be displayed in browsers on handheld devices, developers can create user interfaces that are completely responsive per the needs of different devices and screen sizes.

Securing all layers of the architecture. FDT 3.0 enables open, secure and scalable skid-to-cloud architectures and sensor-to-cloud integration. At the same time, it includes inherent security features that complement their own detailed security models. FDT deploys a secure by design approach, including robust security at all points of ingress or egress in the architecture—from the DTM to the network layer and across all related components. The technology features multi-layered security and leverages vetted industry standards such as transport layer security (TLS) enabling web sockets secure (WSS) and hyper-text transfer protocol secure (HTTPS). This security strategy encompasses encrypted communications using TLS, role-based user security, 509v3 certificates for authentication and on-the-wire-security for enabled industrial control protocols.

Developing a Standardized IIoT Ecosystem

The IIoT facilitates digital transformation by providing manufacturers with more data that can be used to achieve operational excellence, but for this to occur businesses must make use of the wealth of new information.

Connectivity protocols enable end users to collect and transfer more data quickly and accurately, from sensors up to the cloud, for data aggregation and analytics. New IIoT platforms are key differentiators supporting data consolidation and communication across multiple machines, facilities and companies, creating connected organizations and supply chains.

Clearly, no company or organization has the capabilities and resources to do it all in the IIoT. Instead, businesses targeting this opportunity must be part of an ecosystem.[5]

Supporting the fourth industrial revolution. The FDT 3.0 standard is positioned to speed up the evolutionary journey into the Fourth Industrial Revolution by enabling an ecosystem of FDT-based solutions to meet demands for IIoT and Industry 4.0 applications.

Within the FDT IIoT Ecosystem, each solution auto-enables OPC UA integration and allows the development team to focus on value-added features that differentiate their products, including WebUI and App support.

The FDT IIoT Ecosystem development environment simplifies the journey to innovative solutions supporting standardized sensor-to-cloud data integration. With this approach, system and device suppliers can take a well-established standard and create customized, data-centric, cross-platform FDT IIoT solutions.

As FDT represents the leading global standard for universal device and network integration for both the process and the factory automation markets, it is engineered for use with all major industrial communication protocols and proprietary protocols with full transparent tunneling through any mixed network topology.

FDT supports leading industrial standards, protocols and platforms such as:

Modernizing development efforts. Along with the FDT 3.0 standard, the FDT Group has delivered a comprehensive development environment enabling a compelling business case for the rapid and cost-effective engineering of FDT 3.0 IIoT-enabled solutions. The scalability, secure remote access and data-rich environment that FDT 3.0 provides drives the realization of next generation automation solutions from which customers will benefit today.

FDT Group's latest toolkits greatly reduce the burden of development work and save time and money when bringing new product offerings to market. The toolkits are essential to improving overall quality and interoperability for the industrial installed base.

Automation suppliers can obtain development tools directly from FDT Group and access the necessary licenses and standards for their development initiatives. Specification licenses are mandatory for FDT 3.0 development (FDT Group members receive significant discounts on these items). Additionally, all DTMs are certified under the new FDT 3.0 standard requirements. They are the driving force for the standardized IIoT ecosystem for sensor-to-cloud and enterprise-wide interoperability.

FDT 3.0-based Common Components toolkits (Server and DTM) have been engineered out-of-the-box to deliver platform agnostic solutions. This means the resulting components can be deployed on Windows, Linux or Apple operating systems. In fact, the Server Common Components can even be compiled and employed as a working FDT Server without need for any additional engineering.

For example, the FDT Server Common Components has a built-in, platform-independent OPC UA Server, which is prewired, pretested and ready for immediate deployment. This solution alleviates headaches for developers by eliminating the learning curve for implementing an OPC UA Server and integrating it with an FDT application.

In addition, the FDT Server Common Components integrates the necessary Web Server to support all the browser-based clients authorized to access the FDT architecture. The toolkit includes a pre-built Web Server, eliminating web service development and mobilizing operations.

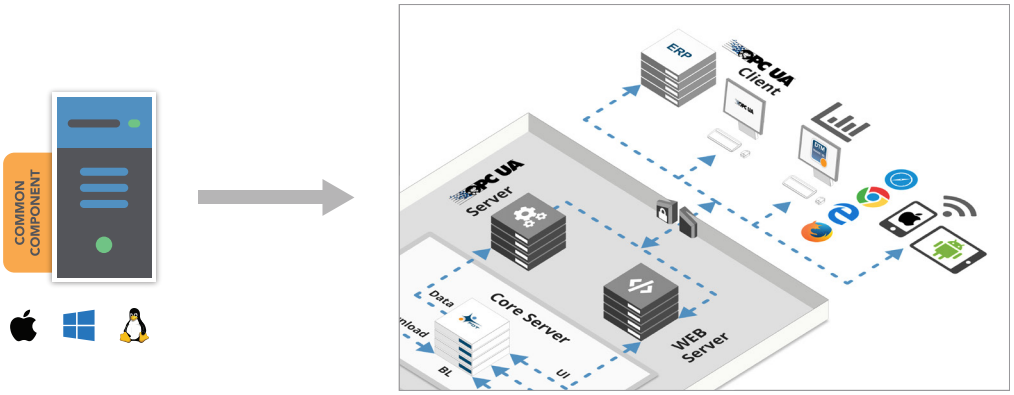


Figure 5. FDT Server Common Components natively integrates an OPC UA Server and Web Server.

The FDT 3.0 DTM Common Component toolkit is essential to streamline development of compliant DTMs to fully support a standardized FDT IIoT ecosystem unlocking universal device integration communication within an application. The DTM Common Components supports development of any type of DTM, including Device, Interpreter, Universal, Communication and Gateway DTMs. While the DTM WebUIs may be developed with any tool of choice (e.g. the Angular web application framework), the DTM CC focuses on development of the DTM business logic and integration of all parts (e.g. business logic, documentation and WebUI) to a deployable package. The resulting DTM may be executed in an operation system-agnostic environment to provide device data and a web-based Graphical User interface to present asset-related information. This approach eliminates the constraints imposed by a traditional Windows environment.

Once a DTM is developed, it is subject to rigorous testing by an accredited, third-party test site using dtmINSPECTOR. After testing has been done and an FDT certificate has been granted, the DTM is uploaded to the FDT*hub* repository providing easy access to all certified DTMs. This process greatly reduces the burden of development work and saves time and money when upgrading from a previous version of the standard or bringing new product offerings to market.

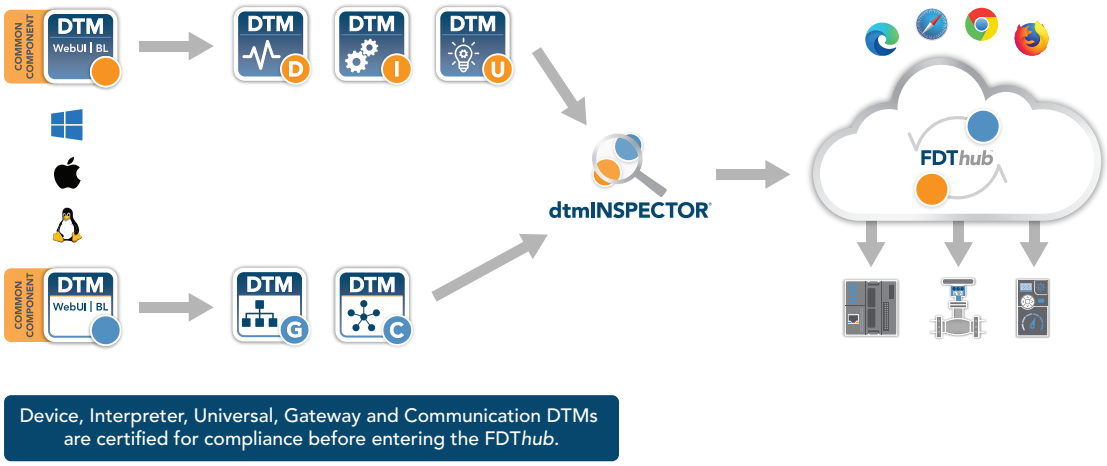


Figure 6. FDT/DTMs are subject to rigorous testing by a third-party accredited test site using dtmINSPECTOR.

Enhancing human-machine interactions. FDT Group's technology developments have continued to advance upon a successful, uniform user interface across vendors. No other industrial standard offers a more comprehensive style guide approach and templates for the UI.

The FDT interface is tried and proven for efficiency due to its ease of use. Recent developments have enhanced the user experience with a standardized web UI, which is key to successful monitoring. Now, with FDT 3.0 and its updated style guide, the approach to the DTM interface includes a completely uniform, responsive design focused on mobilizing secure remote access independent of the device, system, browser, phone, operating system, etc. The style guide describes elements of the automation interface in the HTML5 JavaScript world, so it is state of the art. The Web UI is suited to a new generation of workers who are digital natives and expect to use web-based technologies.

Style guide conformance is required for a standardized/uniform user experience for FDT 3.0 DTMs—all major navigation and information points are presented in the same fashion, no matter the manufacturer, device or device type. Additionally, all FDT 3.0 DTMs are compliant to show NAMUR NE 107 status symbol recommendations for improved predictive maintenance, diagnosis and issue resolution. FDT provides a single interface, and the same look and feel experience, which is responsive by design to create the best user experience for interfacing with each device. Its Web UI is streamlined and efficient for asset management and optimized maintenance strategies.

Figure 7. DTM Layout Overview
(the layout is divided into different areas to ensure the most relevant data at a glance and intuitive user interactions).

Figure 8. Flowserve prototype of FDT 3.0 DTM based on the new responsive design approach.

Leveraging platform independence. Many host and device suppliers view platform independence as FDT 3.0's most crucial feature, since it provides cost control capabilities through the elimination of certain software licenses. Moreover, end users no longer have to manage and maintain different versions of their software and operating systems.

The FDT IIoT Ecosystem's platform independence results in greater freedom of choice in the use of development tools. This is especially the case for those who are working on web-based user interfaces.

Innovating Business Strategies

Industry-driven feedback indicates the "sky is the limit" with the FDT 3.0 standard and its new, modernized development environment. Automation suppliers are jump-starting development efforts to enhance their product offerings with standards-based, platform-independent, information-driven business models to serve customers in all industrial markets.

Responding to end user needs. Today's FDT solution offers a wide range of benefits for automation end users around the world. It helps them take control of their critical operational data and obtain the information they need from different networks and devices—regardless of any protocol constraints.

FDT is a powerful, data-centric integration technology that can bridge current automation assets and support any proprietary network. The technology provides expanded access to data from a single, centralized location so analysts can make better use of the information to improve plant or factory operations.

End users can install a single instance of an FDT Server and make it accessible across their facility for deployment. And, all real-time data from installed devices is automatically available through OPC UA to enterprise-level applications such as manufacturing execution systems (MES), enterprise resource planning (ERP), computerized maintenance management systems (CMMS), and dashboards.

Providing a scalable server solution. The new FDT Server empowers a scalable solution and provides end users with flexible options on how to distribute their data within the enterprise with pre-wired OPC UA and Web servers. The FDT Server environment can scale from a small, low-cost Linux box running a remote OEM skid asset management environment, up to a multi-facility, enterprise-wide, cloud-based installation. Any class of FDT Server is securely accessible through any authenticated web browser or OPC UA client from anywhere in the world. For the vendor and services communities, this scalability is achieved with a single development environment that can deploy under a wide variety of operating systems and server classes.

Significantly, with FDT 3.0, there is no need for automation stakeholders to develop their own IIoT server. They can deploy the FDT Server with native OPC UA capabilities and web services right out of the box with no additional coding required. Development of a proprietary server solution can often require years of work by a dedicated team of specialists which often results in another automation island rather than a multi-vendor integrated solution.

Implementing FDT as a service. FDT Group's new standard also enables "FDT-as-a-Service," whereby multiple instances of the technology are pre-deployed in the cloud and a hosted service and project structure are set up with all devices and networks pre-populated. This allows for the implementation of a complete, turnkey system without having to touch the infrastructure itself.

Expanding solution offerings. Automation product and service providers have many reasons to be interested in the latest FDT technology developments. The release of FDT 3.0 will dramatically change the outlook for the worldwide automation community. The modernized approach inherent in the updated standard "lowers the bar" for companies seeking to take advantage of this innovative technology while greatly optimizing developer performance.

For device suppliers, the FDT Server platform improves their business model by allowing for creation of a new generation of DTMs that will seamlessly integrate with any server or desktop hosting environment. This approach holds the key to unlocking universal device integration, bridging the current FDT installed base with next-generation technology, while creating an excellent starting point for new applications.

FDT 3.0 helps device suppliers meet market demands by moving away from package-based to service-based selling. This solution will allow them to sell their solutions as a service rather than just a product. The technology allows measurement and control data to be pushed to a centralized server where it can be easily accessed and interpreted for its meaning to the customer's process operation, asset management program or maintenance routines.

For service providers, the new generation of FDT technology enables them to provide custom apps to support the customer's standard operating procedures. The service provider can leverage web services and the OPC UA Information Model within the FDT Server to process and present data in a unique fashion to support the customer. As an example, consider an app installed on a smart device that geo-locates where the user is within a facility to alert engineers to any equipment that may need attention in that area.

For host suppliers, FDT 3.0 optimizes their general diagnostic features as a first point of notification when further analysis is required by specialist device vendors.

Summary

FDT is widely installed as the de-facto integration standard for industrial automation and has built upon its success with industry-driven feedback to become the essential data-centric integration platform transforming the outlook for automation suppliers and the customers they serve around the world.

Recognized as a critical technology for the new era of automation—providing built-in mobility, native OPC UA integration, robust security, and platform independence—the FDT 3.0 IIoT ecosystem paves the way for innovative business models that empower IIoT and Industry 4.0 solutions in both Greenfield and Brownfield applications in the process, hybrid and discrete manufacturing markets.

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