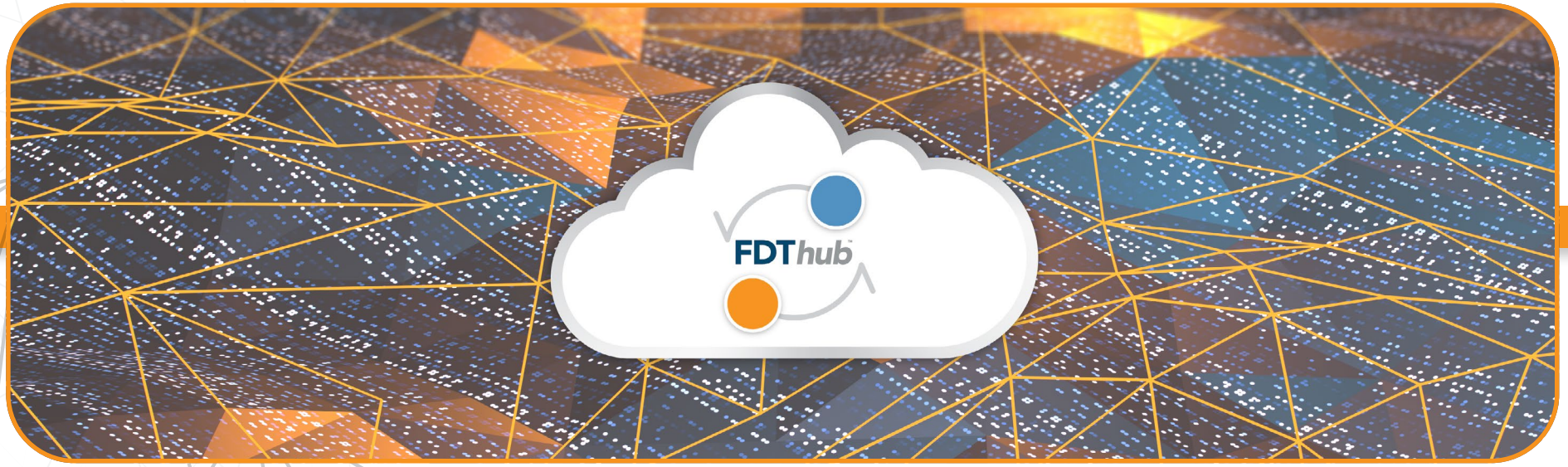

FDT GROUP

Device Integration Strategies

Empowering the Intelligent Enterprise

What is FDT® Technology?

The FDT Group AISBL is an international non-profit corporation consisting of leading worldwide member companies active in industrial automation and manufacturing. The major purpose of the FDT Group is to provide an open standard for enterprise-wide network and asset integration, innovating the way automation architectures connect and communicate sensor to cloud for the process, hybrid and factory automation markets. FDT technology benefits both manufacturers and end users, with advancements such as the Industrial Internet of Things (IIoT) and Industry 4.0 delivered out-of-the-box – enabling modernized asset integration and access to performance data for visualizing crucial operational problems. Around the world, end users, manufacturers, universities, and research organizations are working together to develop the technology; provide development tools, support, and training; coordinate field trials and demonstrations; and enable product interoperability.

FDT has long focused on bringing plants, people and data together. With the new Fourth Industrial Revolution era now here, FDT has strengthened its standard focused on empowering the intelligent enterprise with the release of the new FDT IIoT Server™ (FITS™) platform. The enhanced solution transforms the standard into an information exchange architecture. Empowering innovative business models, FITS features a solid ecosystem of solutions (FDT Server, FDT Desktop, FDT DTM and FDT App) supporting IIoT and Industry 4.0 applications. Built from the ground up with an operating system agnostic environment and a comprehensive security solution, a FITS enabled environment boasts OPC UA integration, mobile device management and a new FDThub™ DTM repository. Designed to be flexibly integrated, the architecture is deployable in the cloud, on-premise, edge or desktop environment supporting FDT's heritage and future as the open, standardized, platform independent architecture for universal device integration and asset management.

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Table of Contents

Editorial: FDT 3.0 (FITS) to Launch with FDT*hub*

Secure online and offline DTM repository meets use case requirements benefiting suppliers and end users

Lee Lane, FDT Group Chairman of the Board of Directors

As I write this, we are just completing the final prototyping activities for our exciting new FDT 3.0 (FITS) standard. By our next newsletter, the new standard and all related development tools will be available to the market empowering next generation FDT-based solutions for IIoT and Industry 4.0 applications with options to bridge the current install-base. It has been a fast paced but carefully managed process that had many parallel tasks across the organization. It is exhilarating to see it cross the goal line. I am very proud of the entire team that has brought this effort to life in record time. Be sure to download the new FITS architecture brochure that provides a high-level overview about the emerging standard set to deploy in March 2020.

One area of the FITS portfolio that is drawing a lot of attention is the new FDT*hub*. This cloud-based infrastructure will house all certified FITS device and communication FDT/DTMs making them available to any registered FITS-based FDT Server or Desktop application. This completely eliminates the drudgery of searching on websites and DVDs for the FDT/DTM for the devices in the project structure. Instead, the FDT Server or Desktop application will automatically retrieve them from the cloud as needed – no visiting a special website and no worrying about file names and device versions.

The FDT*hub* will also alert any registered FDT Server or Desktop application when an updated FDT/DTM is available. The user can then decide to install the upgraded version or stay with the existing version. This will be a real benefit for end users to be automatically notified as vendors add new features to DTMs or otherwise update their DTM.

While the FDT*hub* is engineered from the ground up with a robust security model, we know some end users will not have access to the FDThub via the internet. We will be rolling out a locally installable version of the FDT*hub* for these high security, air gapped end users. Contact the FDT Business Office or your local automation supplier for more details.

Look for the featured article, "FDT*hub* Repository Eliminates Device Management Headaches", in this newsletter for more details on the capabilities and benefits the new FDT*hub* will offer.

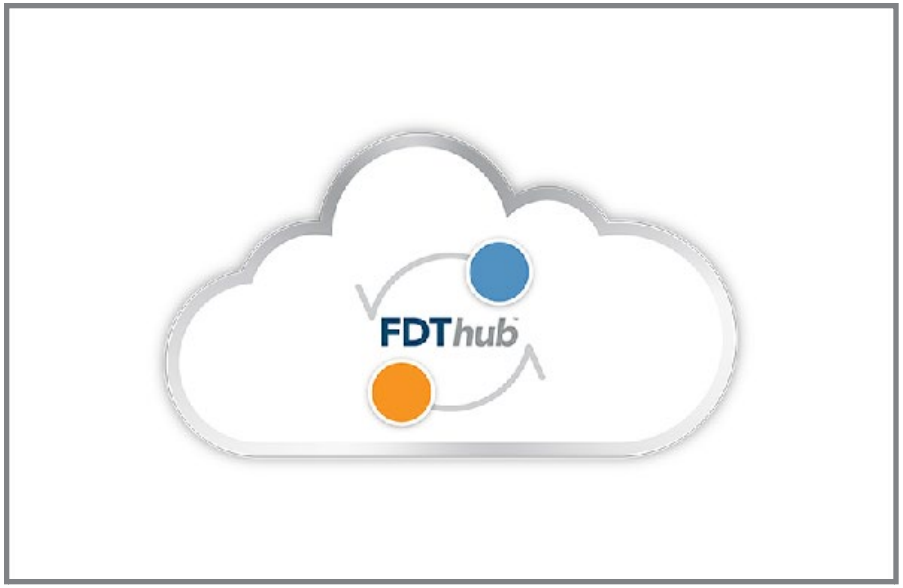
FDT*hub*™ Repository Eliminates Device Management Headaches

Automation stakeholders will benefit from secure DTM/App management and storage in the cloud

Suriya Selvaraj, VP of Technology - FDT Group

In all types of industrial plants and factories, there is a need to optimize the management of intelligent field devices such as photo eyes, drives, HMIs, transmitters, meters and valves. For some end-users, management of these devices is difficult and complicated—especially when dealing with multiple suppliers and field communication protocols.

Until now, configuration of intelligent devices was a time-consuming aspect of industrial automation projects. A new, cloud-based repository implemented by FDT Group for FDT Device Type Managers™ (FDT/DTMs™) promises to streamline the DTM installation and update process—saving valuable engineering hours and helping to expedite project execution.



Why FDT/DTMs Are Important?

Developed and managed by FDT Group, an independent, international, not-for-profit industry association supporting the advancement of process, factory and hybrid automation, FDT technology enables industrial organizations to parameterize, monitor, diagnose and troubleshoot a wide range of automation devices. The FDT/DTM is a core component of this solution. It contains the application software that defines all the parameters and capabilities for simple to the most complex devices.

Today, millions of FDT/DTMs are installed around the world—from small facilities to large complexes running thousands of Input/Output (I/O) points in demanding industrial applications.

The FDT/DTM encapsulates all device-specific data, functions and business logic rules such as the device structure, its communication

Continued

FDT*hub*™ Repository Eliminates Device Management Headaches

capabilities, internal dependencies, and Human-Machine Interface (HMI) structure. It provides a centralized remote access point for horizontal and vertical data flow, allowing for a safer work environment by reducing the number of trips to the field and lowering start-up and commissioning costs.

Experience has shown that FDT/DTMs bridge the chasm between different communication protocols used across facilities and industries and, as such, support a wide range of automation tasks. The traditional boundaries between areas of control do not exist for this technology, making it easier for engineers and production managers to set up seamless asset management.

With thousands of certified Device and Communication DTMs available today, automation, maintenance and operations engineers and managers look for certified DTMs for their current installed base to maximize the full benefit of smart devices.

New Technology Developments

FDT technology is the key to integrating any device, system or network in today's complex automation architecture. The ongoing advancement of FDT is leveraging major developments like the Industrial Internet of Things (IIoT) and Industry 4.0, so end-users can realize the potential of decentralization, interoperability, integration, as well as a unified view of all data and functions across disparate control applications.

Automation product developers have reason to be interested in the latest FDT technology developments. The upcoming release of the FDT IIoT

Server™ (FITS™) architecture will dramatically change the outlook for the worldwide supplier community. The modernized approach inherent in FITS "lowers the bar" for vendors seeking to take advantage of this innovative technology while greatly optimizing developer performance.

The FITS-enabled FDT Server platform enhances the device supplier business model by allowing creation of a new generation of DTMs that will seamlessly integrate with any Server (multi-user) or Desktop (single-user) hosting environment. This approach holds the key to unlocking universal device integration with important advantages such as platform independence, mobility solutions, and a contemporary development environment to reduce costs and expedite the DTM certification process.

For device vendors, FITS-enabled FDT/DTMs will provide fit-for-purpose solutions for tasks such as deep inspection diagnostics and prognostics enhancements driven by artificial intelligence. All FITS DTMs comply with the NAMUR NE-107 recommendation, which stipulates that operators need a view of the process including the status of the instrumentation in a simple and uniform way—regardless of source device—to support predictive maintenance strategies. The DTMs will also be a key enabler for Apps intended for viewing the health of field devices, and subsequently improve maintenance workflows.

Addressing Supplier Challenges

Despite the importance of FDT/DTMs to the new era of industrial automation, experience has shown that managing these crucial software drivers can be a complex and laborious process. Many suppliers struggle with the challenges of managing DTMs for their customers' intelligent devices, so having an easy-to-access repository that can store and manage DTMs and Apps would be extremely beneficial.

Historically, automation end-users have had difficulty finding the FDT/DTMs they need to deploy field devices within their automation project. A project involving a hundred unique field devices, for example, could require up to 15 minutes to locate each device DTM—and thus involves several days' worth of installation work. This engineering burden had the potential to put device commissioning on the critical path.

FDT Group's FITS platform development addresses traditional device configuration challenges by incorporating a cloud-based FDT*hub*™, which provides a centralized location for hosting of all FITS-capable DTMs (based on the FDT 3.0 specification). Future plans call for expansion of the repository.

Continued

FDT*hub*™ Repository Eliminates Device Management Headaches

The FDT*hub* provides convenient access to certified FITS Device and Communication DTMs in a single, online repository. This versatile resource is designed for cloud-based or air-gapped Desktop/Server deployment with automatic asset discovery, as well as support for machine-to-machine communications with 509 electronic security certificates for machines with authorized access. An end-user with a FITS-enabled Server or Desktop application at one of their locations simply applies for access to the FDT*hub* for that site. Upon approval by FDT Group, they receive a 509 certificate that can be installed within their respective application. This step provides automatic authorization for the application to access the repository in the background to obtain DTMs. No password or log-in information is required.

When implementing an automation project, end-users won't have to go searching for FDT/DTMs for their field devices. All of the correct DTMs will be located in the FDT*hub* and made available for automatic download and installation. As such, there will no longer be a need for control engineers or maintenance technicians to visit individual device manufacturers' websites to obtain the appropriate device software.

Any time the FITS application determines that a device has been added to a network, it will retrieve the proper FDT/DTM without requiring operator intervention. If a device is already installed, FITS will check the FDT*hub* to determine if a new DTM is available, and if so, it will give the end-user the option to utilize the new DTM or continue operating with the existing software.

For use with the FITS solution, all DTMs must be certified. Once a DTM is sent to an independent test lab for certification and passes the required tests, it is immediately forwarded to FDT Group for uploading to the FDT*hub*. This approach streamlines the certification process and eliminates the need for manual intervention by device suppliers. They can provide their customers with immediate access to current DTMs without having to maintain a hosting website, distribute CDs, etc. The entire DTM distribution process is transparent to the end-user; as soon as they install the vendor's device, the DTM automatically appears for it. The FDT*hub* also assists the supplier community by providing automatic export compliance.

Benefits for Automation Stakeholders

The FDT*hub* offers significant benefits for both automation manufacturers and end-users around the world. Its cloud-based repository capability eliminates a number of DTM management headaches for device vendors while providing end-users with greater confidence and ease of use.

Continued

FDT*hub*™ Repository Eliminates Device Management Headaches

With the FDT*hub*, certified FITS DTMs can be automatically downloaded from the cloud for use in on-/off-premise server and desktop applications. The repository provides convenient DTM/App storage and device management, as well as secure data transfer and messaging with proactive user alerts when DTM updates are available.

The FDT*hub* also makes it possible to deploy "FDT as a Service" with convenient online access to the latest certified FDT/DTMs. A helpful device discovery capability triggers automatic download or search results in the case of multiple DTMs. The repository provides a secure portal allowing vendors to authorize/de-authorize customers; view reports and download history; upload, update, remove, or suspend DTMs; and configure their export compliance.

Conclusion

With the FDT*hub*, instrumentation end-users will no longer have to search for the device software need need—locating FITS DTMs only takes a matter minutes since all certified DTMs are available at a single, online location. This is another example of the modern, user-friendly features provided by the FITS platform for the industrial automation sector. FDT Group has listened to the marketplace and responded to its needs with key technology advancements.

Asset Health Monitoring Using FDT 3.0 (FITS) & OPC PubSub

White paper focuses on the FITS architecture by enabling the OPC UA Server with OPC PubSub mechanism

Authors: Dharmaraju B, Smitha Rao, Abhishek MR, Sharan Basayya - Utthunga Technologies

Abstract

In an industrial environment, asset health monitoring is key for making informed decisions about maintenance activity, component replacement etc., to reduce the plant downtime and improve asset performance.

FDT Group's emerging FDT IIoT Server (FITS) architecture empowers a robust FDT Server solution featuring a client-server architecture scalable to suit the needs of a single manufacturing facility or an entire industrial enterprise by enabling secure mobile, cloud, on-premise, edge and enterprise-wide applications. The FDT Server natively integrates an OPC UA Server which exposes information about the devices connected to the FDT Server via the OPC UA companion specification Information Model. Any authenticated OPC UA Client can fetch the device information from the OPC UA Server via Request-Response Pull mechanism. This paper focuses on the FITS architecture by enabling the OPC UA Server with OPC PubSub mechanism, so that the remote asset health monitoring application can monitor the asset health in a different network, using various messaging protocols like AMQP, MQTT utilizing pull mechanism.

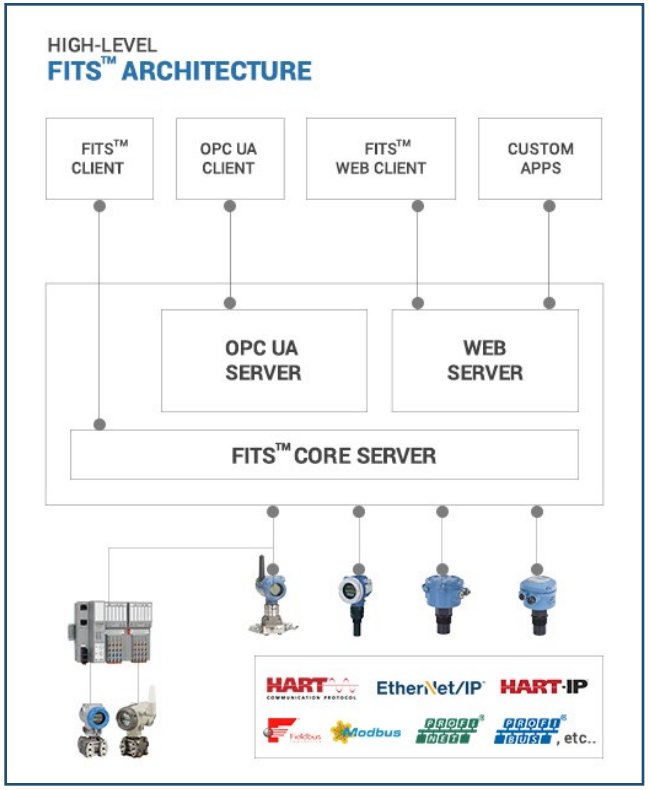
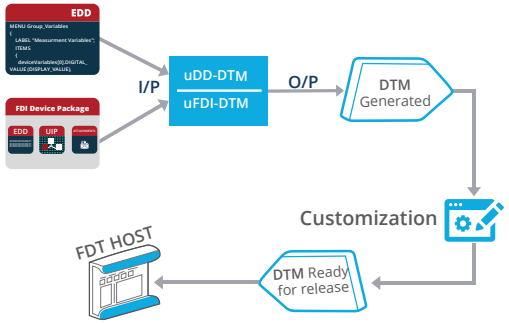


Fig.1 FDT Server - FITS Architecture

This reduces the message traffic between Asset Health Monitoring Application and the FDT Server, improving the performance and scalability.

DD/FDI Package to DTM + Customization = Easy Integration



Popular device integration standards such as EDDL, FDI and FDT/DTM enable these rich functionalities empowering the 'smarts' for these intelligent devices as 'drivers' providing a consistent device management solution for commissioning, configuration and maintenance. Based on customer needs, when a new software version is available or new customization is required, the device suppliers are overloaded with the required maintenance for all three of these device integration solutions, sometimes making the entire device development cycle - especially migration from EDDL and FDI solutions to FDT/DTM is a time consuming and costly task.

Based on decades of experience in offering more than 500+ device integration solutions to device suppliers, we at Utthunga understand the challenges and have an innovative solution for developing and maintaining DTMs based on existing DD or FDI using the uFDI-DTM/ uDD-DTM development tool.

The uFDI-DTM / uDD-DTM solution has four simple steps:

1. Take your DD/FDI Device Package
2. Convert that to FDT 1.2x/2.x DTM
3. Understand your requirement for Customization
4. Deliver the customized generated DTM

Features:

- Supports FDT 1.2.x, 2.0 standards and complies to FDT style guide
- Supports HART, PROFIBUS and FF (FDT 1.2x) protocols
- UIP hosting support including direct access
- Device Health Status
- Offline/Online Configuration
- Upload/Download
- Interoperable all major FDT Hosts

We offer a comprehensive, robust, customizable, easy maintenance and cost-effective conversion tools. We can help you to solve your entire device development cycle maintenance problems. For more details connect with us.

Continued

Asset Health Monitoring Using FDT 3.0 (FITS) & OPC PubSub

1. Introduction

FDT is an international, IEC-62453 open standard for industrial automation integration of networks and devices, harnessing IIoT and Industrie 4.0 for enterprise-wide connectivity.

2. High-Level FDT IIoT Servce-FITS Architecture

The FITS standard employs the latest technology to allow for a server-based solution that is operating system independent. The FDT Server is a turn-key solution inclusive of a Core Server that functions as the IIoT exchange hub and manages all DTM user interfaces and business logic. Additionally, the Core Server is responsible for DTM storage, instances and execution. In addition to the Core Server, the FDT Server contains components mentioned below.

1. OPC UA Server: OPC UA Server exposes the FDT/OPC UA Information Model via OPC interface for any authenticated OPC UA Client. The FDT/OPC UA Server Information Model contains the internal client component which interacts with the Core Server to fetch the DTM related information to map it to the FDT/OPC UA Information Model.

2. Web Server: Web Server provides the web interface for authenticated remote web-enabled client applications. It is also possible to have the custom application built based on the Web Server using AppData Services.

3. Asset Health as Per Namur NE107 Recommendation

NAMUR has identified that the status of the devices is important to help the plant operators run the plant better

Failed	Out of Specification	Maintenance Required	Check Function
			
High severity: signal invalid due to malfunction in the device, sensor, or actuator	Medium severity: permissible ambient or process conditions exceeded or the measuring uncertainty of sensors or deviations from the set value in actuators is probably greater than expected	Low severity (advisory): although the signal is valid, the remaining life is nearly exhausted or a function will soon be restricted due to operational conditions e.g. aging of a pH-electrode.	Signal temporarily invalid (e.g. frozen) due to on-going work on the device.

Fig. 2. NAMUR NE107 Status Signal Description

along with measured process values. This requirement is captured in their NE107 recommendation defining that detailed device-specific diagnostics are summarized as four simple status signals (Failed, Out of Specification, Maintenance Required and Check Function). These signals ensure that the plant operator is not inundated with device troubleshooting details and cryptic error codes. The NAMUR NE107 recommendation harmonizes the display of status for devices.

4. Monitoring Asset Health Using FDT Server and OPC PUB-SUB Mechanism in FITS

This position paper focuses on the Asset Health Monitoring using the FDT Server's flexibly integrated OPC UA Server along with OPC UA PubSub mechanism. There are other possibilities of monitoring asset health using the embedded Web Server and building custom application. However, this paper does not cover these possibilities.

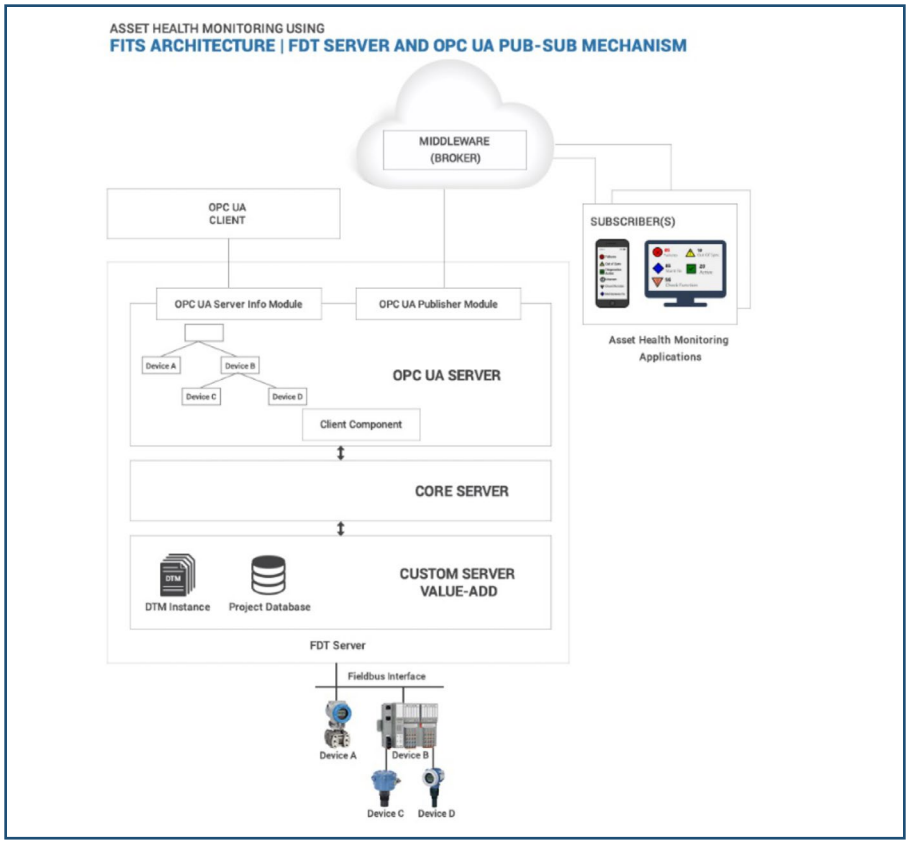


Fig.3. Asset Health Monitoring Using FDT Server and OPC PubSub mechanism in FITS architecture.

OPC UA			FDT Server Mapping			
Object Type	**BrowseName/ TypeDefinition**	**DeviceHealth Value**	**FDT Interface**	**DTMService (IEC62453-2)**	**FDT 3.0 Method**	**DeviceStatus.StatusFlag**
FDT DeviceType	DeviceHealth/ BaseDataVariable Type	NORMAL_0 FAILURE_1 CHECK_FUNCTION_2 OFF_SPEC_3 MAINTENANCE_REQUIRED_4	IOnlineOperation	DeviceStatus	Request: IOnlineOperation.BeginReadDeviceStatus Response: IOnlineOperation.EndReadDeviceStatus	Ok Invalid Check Function Outof Specification Maintenance-Required

Table 1. Mapping of FDT Interfaces to OPC UA DeviceHealth Status Information

As shown in the above image, disparate network and devices in the plants are connected to the FDT Server and are modeled in the FDT/ OPC UA Information Model as per the companion specification. DTM instances will be fetched by the Core Server while client component in the OPC UA Server Information Model will use this information to build the FDT/OPC UA Server Information Model.

4.1 Mapping of FDT Interfaces to OPC UA DeviceHealth Status information

OPC UA Server shall support access to both offline and online information. However, DeviceHealth Status is applicable only for Online Devices. Below table maps the OPC UA Object Type for DeviceHealth information to FDT Server Interface.

As per FDT 3.0 (FITS) specification, ReadDevice Status method available in the IOnlineOperation interface is an asynchronous operation. FDT also provides StaticFunction GetDeviceStatus to return the DeviceHealth values which can also be mapped to OPC UA DeviceHealth attribute.

Along with DeviceHealth Status, it is also possible to include Device Diagnostic Information and map it to the OPC UA Information Model. However, this has not been discussed in this position paper.

4.2 OPC UA Publisher Module for OPC UA Server in the FITS Architecture

This position paper proposes the OPC UA PubSub model on top of the OPC UA Server to support pushing the DeviceHealth Status in the event of status change instead of OPC UA Client polling the DeviceHealth information on time-based interval. OPC UA PubSub Communication Model is based on a well-known Publisher-Subscriber design pattern where publisher and subscriber are loosely coupled. With PubSub Communication Model, OPC UA application does not exchange the information directly using the request-response mechanism, instead, OPC UA publisher module sends the message/topic to the Message Oriented Middleware (Broker).

Message Oriented Middleware could be software or hardware infrastructure which supports sharing the information between publishers and subscribers. OPC UA PubSub Communication mechanism supports both broker-less and broker-based middleware.

The broker-less mechanism uses the UDP multicast whereas in broker-based mechanism uses the standard messaging protocols like AMQP or MQTT to communicate with broker.

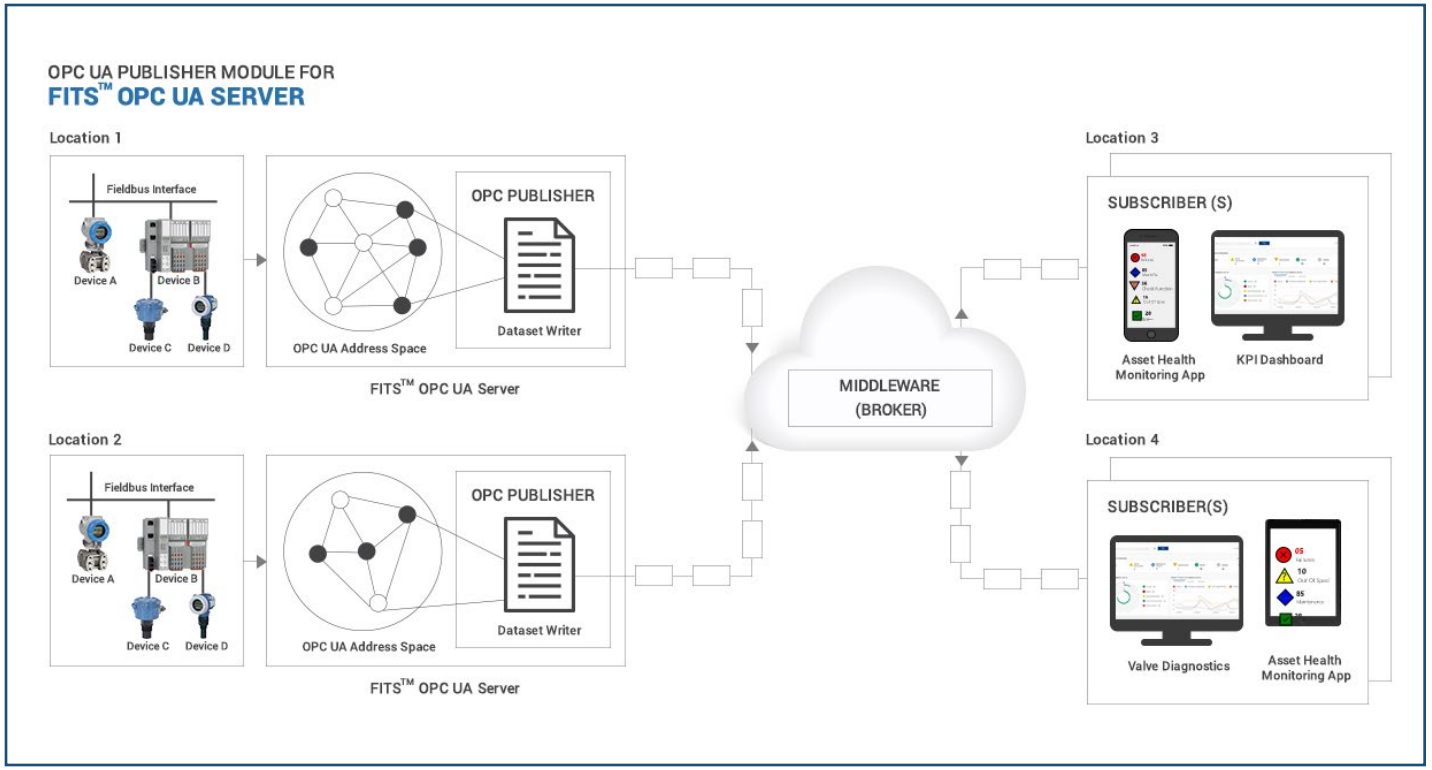


Fig.4. OPC UA Publisher Module for OPC UA Server in the FITS Architecture

OPC UA PubSub Communication Model supports two types of DataSet Messages - Key Frame and Delta Frame messages. A key frame DataSetmessage includes all fields of the DataSet whereas Delta Frame message includes only subset of fields that changed since the previous DataSetMessage.

5. Benefits

OPC UA PubSub Model enables the Asset Health Monitoring Applications (Subscriber) to pull the interesting data i.e. topics from the cloud platform without any knowledge about the FDT Server (Publisher) of the data. However, these messages will be associated with

its metadata information which enables the subscriber to interpret this information correctly.

FDT Server (Publisher) and Asset Health Monitoring Application (Subscriber) do not have to be directly addressable. They can be anywhere in their own networks as long as they have access to the broker.

Fan out can be handled against a very large list of subscribers, multiple networks or even chained or scalable brokers. Publisher and subscriber lifetimes do not have to overlap. The publisher can push data to the broker and terminate. The data will be available in the subscriber application which can be accessed later.

OPC UA PubSub Model is independent of the cloud platform and messaging protocols like AMQP or MQTT. This enables the existing application to easily adopt this technology with less investment.

6. Study Point

This position paper covers the study point of comparing the existing FDT/OPC UA Information Model for FDT Server with FDT/OPC UA Information Model enabled with the OPC UA PubSub module for Asset Health Monitoring.

7. Conclusion

FDT Server (Publisher) can push the data to the broker only on change of status which brings huge benefit in reducing message exchange between the Asset Health Monitoring Application and the FDT Server.

OPC UA Server supports Client-Server based Request-Response Communication mechanism between the OPC UA client application and generic client application. Combining the OPC UA Pub-Sub communication mechanism with OPC UA Server brings huge benefit in reducing the communication traffic between the Asset Health Monitoring Application and

Key Features	Asset Health Monitoring using OPC UA Server with OPC UA Client/Server communication model	Asset Health Monitoring using OPC UA Server with OPC UA PubSub communication model
Information exchange mechanism between OPC UA Server and Asset Health Monitoring application	Pull Model using Request/Response mechanism: Asset Health Monitoring application needs to pull the information from OPC UA Server at regular interval irrespective of Asset health status change	Push Model using Publisher-Subscriber mechanism: OPC UA Publisher module in the OPC UA Server pushes the Asset Health status only when Asset health status change is detected. This brings huge benefit in reducing message exchange between Asset Health Monitoring Application and the FDT Server
Connection between OPC UA Server and Asset Health Monitoring application	Tightly coupled: OPC UA Session must exist between OPC UA Server and Asset Health Monitoring application.	Loosely coupled: There is no direct connection between OPC UA Server and Asset Health Monitoring application. This allows both of these applications to be in different network.

OPC UA Server application, making it scalable to IIoT requirement.

Apart from Asset Health Monitoring, this position paper can also be extended to support Loop & Control Valve Diagnostics, Equipment Diagnostic, KPI Monitoring and Dashboard Application etc.

Utthunga is niche Industrial Software and Solution provider. Utthunga is specialized in Industrial standards, specifications, communication protocols like OPC UA, FDT/DTM, FDI, HART, EtherNet/IP, BACNet, CC-Link, PROFINET etc.

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FDT is the disruptive technology for modern industrial operations, it is a key enabler of the Fourth Industrial Revolution empowering the intelligent enterprise with innovative business models supporting the Internet of Things (IIoT) and Industrie 4.0 applications.

Join other leading companies in the FDT Group today. There are unique advantages for the entire industrial automation industry – end users, suppliers/developers, service providers, universities, and individuals.

For membership information, please visit www.fdtgroup.org

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