FIELD DEVICE INTEGRATION (FDI)

MAKING DEVICE MANAGEMENT EASY

End users have struggled with different forms of device integration technology over the years, but the FDI effort aims to rationalize the worlds' leading technologies for managing information from intelligent field devices. With FDI, managing the flood of information from today's intelligent devices will get much easier. FDI will allow users to focus on how to best use their applications instead of worrying about how everything will connect together. FDI also means reduced development costs for device and system suppliers.

FIELD DEVICE INTEGRATION (FDI)

MAKING DEVICE MANAGEMENT EASIER FOR END USERS

EXECUTIVE SUMMARY

The installed base of fieldbus devices and indeed all intelligent field devices continues to grow significantly. As any experienced user will tell you, however, intelligent devices can pose an information management problem, especially when you have devices on different networks with different underlying technologies for displaying and managing information.

Historically, the two primary technologies used for presenting and managing information from intelligent devices are Field Device Tool (FDT) and Electronic Device Description Language (EDDL™). Both technologies are complementary in some ways and overlap in other ways. Many in the industry felt that rationalizing the two technologies to form a single solution would be a good idea, particularly since all the major suppliers support both FDT and EDDL technology. This was how the Field Device Integration (FDI) project was born.

FDI activities continued, but were somewhat sporadic, until 2011, when all of the five major technology foundations, including FDT Group, HART Communication Foundation, OPC Foundation, PROFIBUS & PROFINET International and Fieldbus Foundation signed an agreement to form FDI Cooperation LLC, a company dedicated to seeing through the development of the FDI specification its associated development tools, and product testing and registration.

The real goal of FDI is to make life easier for the end user. FDI promises a common set of development tools and a single path to managing the flood of information from intelligent devices across different networks to the applications and ultimately the people that need it. It offers standardization, transparency, and, ultimately, reduced

FDI LLC: ONE DEVELOPMENT EFFORT, ONE MISSION

In September 2011, a new joint company, FDI Cooperation, LLC (a limited liability company under US law), was formed. The new company is headed by a Board of Directors that includes representatives from the five major industry technology foundations, including the Fieldbus Foundation, FDT Group, HART Communications Foundation, OPC Foundation and PROFIBUS & PROFINET International. FDI Cooperation LLC is committed to developing a single technology for the management of information from all intelligent devices throughout all areas of the plant.

Please share your comments and feedback with us. Just email us at marketing@fieldbus.org

cost. The Fieldbus Foundation is committed to the long-term success of FDI.

HISTORY OF FDI: EDDL AND FDT

The purpose of FDI is to rationalize Electronic Device Description Language (EDDL) and Field Device Tool (FDT). For a full understanding of FDI, it helps to understand how both EDDL and FDT have evolved and why we need FDI today.
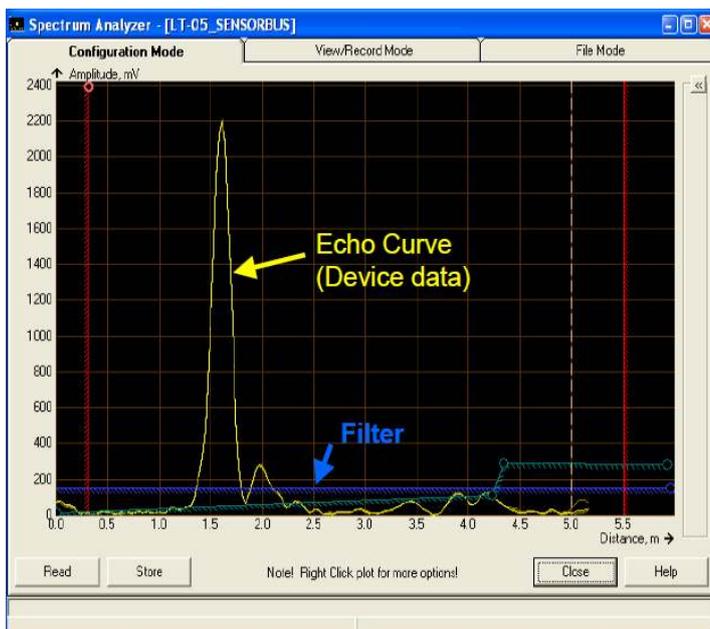
EDDL

EDDL technology is used by major manufacturers to describe the information that is accessible in intelligent field devices. Electronic Device Descriptions (EDDs) are available for millions of devices that are currently installed in the process industry. The technology is used by the major process control systems and maintenance tool suppliers to support device diagnostics and calibration. EDDL is an international standard (IEC 61804) which is supported by the Fieldbus Foundation, HART Communications Foundation and PROFIBUS & PROFINET International.

Virtually every vendor of process control systems supports EDDL and EDDs can be used in any device from a handheld terminal to a process control system. The EDD can be imported any time it is needed and is automatically recognized by the appropriate EDDL interpreter. It helps to think of EDDL as a sort of XML for intelligent field devices. It is a markup language that can help you visualize information and convey information about device parameters in a standard way. EDDL is operating system independent and does not require any machine level execution. EDDL also supports automated procedures or wizards with built in "method calls".

EDDL EXAMPLE: GRAPHICAL REPRESENTATION OF THE ECHO WAVEFORM OF A RADAR LEVEL DEVICE

There have been cross-functional teams that have tried to leverage the power of EDDL across different protocols. The EDDL Cooperation Team was formed in 2003 for this purpose and consisted of the Fieldbus Foundation, HART Communication Foundation and PROFIBUS & PROFINET International. OPC Foundation joined the group in 2004.

FDT/DTM

FDT is accepted as IEC 62453 and supports over 16 protocols used in both process and factory automation, including FOUNDATION fieldbus, HART and PROFIBUS. FDT can do some advanced functions that EDDL cannot do, such as graphical representation of information, and works particularly well with complex devices such as radar level gauges. The FDT Group provides a common
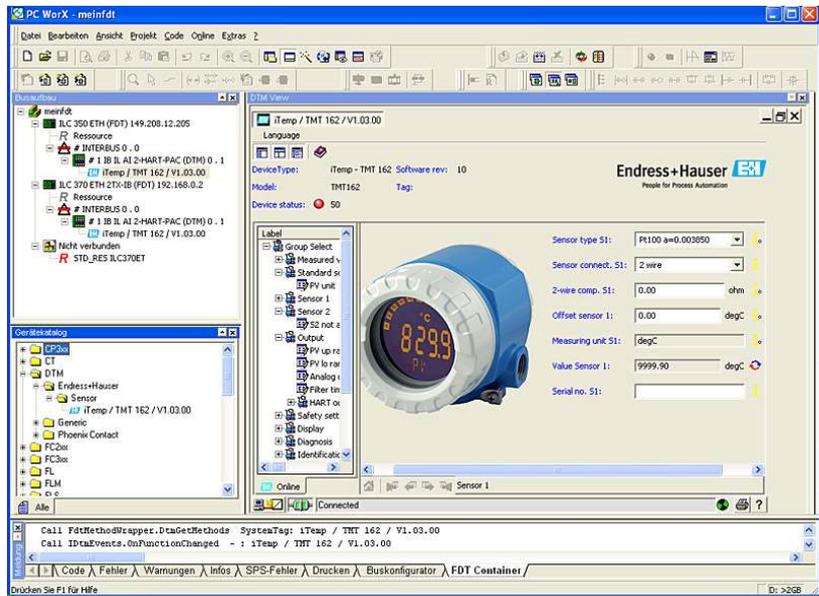
environment for accessing the features of intelligent field devices regardless of the supplier, the host system or communications protocol.

The essential parts of FDT technology are the frame application (FDT Frame) and Device Type Managers (Device DTM and CommDTM), which are available for field devices and communication equipment. The two components are similar to the Print Manager in a Windows Office program and the Print Drivers and their associated GUI that must be installed to make printers work. Device DTMs act as drivers connected to the field device configuration component. The CommDTM connects to the software communication component. They provide a unified structure for accessing device parameters, configuring and operating the devices, and diagnosing problems.

The strength of FDT/DTM technology lies with its ability to interface with devices and process a high level of diagnostic information. The key features of FDT are its

THE DTM AND THE FRAME APPLICATION OF FDT ALLOW FOR MANAGEMENT OF COMPLEX DEVICES

independence from any communication protocol and the software environment of the host system. FDT technology allows any FDT enabled device to be accessed from any compliant FDT host using any field communication protocol.

EDDL and FDT/DTM: Complementary or Competing?

In many ways, EDDL and FDT are both competing and complementary technologies. Regardless of any level of overlap that may exist between the two technologies, end users wanted the best of both worlds. In some cases, their choice of product could be limited depending on what technologies their suppliers were aligned with. Suppliers that wanted to develop products were burdened with increased development costs and duplication of effort. The process automation system suppliers have the additional burden of providing a consistent end user experience. All of these are powerful arguments for some kind of rationalization of EDDL and FDT technology. This was the impetus for the creation of the Field Device Integration (FDI) effort.

What is FDI?

The original technical argument for FDI was developed by the Institute for Information Technologies in Mechanical Engineering of the Institute of Munich's Technical University and was first presented to the public as a white paper at the NAMUR (International User Association of Automation Technology in Process Industries) 2006 Annual General Meeting under the name FDD UA. The Field Device Integration effort was announced in 2007 at the Interkama/Hannover trade fair. The original FDI effort consisted of a combination of representatives from the FDT Group and the EDDL Cooperation Team.

The simple idea behind FDI was to bring together EDDL and FDT/DTM technologies as a uniform device integration solution for process industries across all host systems, devices and the FOUNDATION fieldbus, HART, and PROFIBUS protocols - as required by end users.

FDI has also been involved with several other user associations, such as NAMUR and WIB (International Instrument Users' Association). This involvement includes NAMUR's recommendation NE105 "Specifications for integrating fieldbus devices in engineering tools for field devices". Published in 2004, the recommendations document clearly defines requirements for FDI. The FDI project continued with sporadic progress for the next several years, but it was clear that some additional impetus was needed to bring the project to completion.

Formation of FDI Cooperation LLC

In September 2011, a new joint company, FDI Cooperation, LLC (a limited liability company under US law), was formed. The new company is headed by a Board of Managers that includes representatives from the Fieldbus Foundation, FDT Group, HART Communications Foundation, OPC Foundation and PROFIBUS & PROFINET International. Most of the major process automation suppliers are also lending their support including ABB, Emerson Process Management, Endress+Hauser, Honeywell, Invensys, Siemens, and Yokogawa. FDI probably has the broadest base of support of any technology in the process automation market today.

THE FIVE FOUNDATIONS THAT MAKE UP FDI COOPERATION LLC

FDI Cooperation LLC is committed to developing a single technology for the management of information from all intelligent devices throughout all areas of the plant. The mission of the organization is to:

- Complete the standardization of FDI under the International Electrotechnical Commission (IEC)
- Manage the FDI specification
- Finalize FDI tool kits for system and device manufacturers
- Promote and provide high quality technology support for FDI, independent of and common to the respective communication protocols
- Preserve end user and automation manufacturer investments by providing state-of-the-art technology that is fully backward compatible
- Ensure stability, interoperability, and compatibility of FDI-based products

FDI Addresses Key End User Requirements

FDI promises to address key requirements of both end users and suppliers, both of which are seeking a single solution for management of information from a wide range of intelligent devices. FDI aims to present real-time data in a consistent format that makes plants operate efficiently and safely without confusion. FDI integrates the complementary strengths of EDDL and FDT/DTM technologies with the

advantages of the structured OPC UA standard IEC 62541. FDI Cooperation is developing a solution that is:

- Platform and operating system independent
- Host system independent
- Compatible with existing EDDL and FDT/DTM technologies
- Protocol independent
- An open specification and an international standard
- Provide access to the full capability of the field device, from simple to complex devices
- Compatible with OPC UA technology

FDI technology will provide a scalable solution that users can deploy in applications from simple configuration to complex management of the most sophisticated field devices for tasks associated with all phases of their lifecycle from configuration, commissioning, and diagnostics to calibration. FDI is a truly unified approach, addressing end user requirements across the spectrum, and will essentially eliminate the need for different solutions for different devices.

Ultimately, FDI will be transparent. Users can focus on purchasing the hardware of their choice without worrying about the compatibility with their control host, regardless of field device communication technology. A common FDI solution allows device vendors to focus their efforts and resources on a single technology rather than supporting both FDT and EDDL. This allows the suppliers to focus more on improving the functionality of their products and solutions, instead of supporting multiple technologies to make their applications work across different systems. Fewer interoperability challenges will reduce manufacturing costs and time to market.

> *"Ultimately, FDI will be transparent. Users can focus on purchasing the hardware of their choice without worrying about the compatibility with their control host, regardless of field device communication technology. "*

FDI LLC Project Scope: The Spec and Beyond

With the formation of FDI Cooperation LLC, the overall scope of FDI expanded from simply developing the specification to include a common validation effort and FDI/FDT 2.0 Interoperability. FDI Cooperation will also provide a set of common tools to device developers, including an Integrated Development Environment (IDE) for device package development. Other tools and developments include:

- Host Interpreters
- Package Conformance Tools
- Host Conformance Tools
- EDDL Profile Harmonization and Extensions
- Common EDDL File Format

The Device Package

At the core of the FDI architecture is the **Device Package**. Each field device is represented by a single FDI Device Package, which contains up to four different elements, depending upon the complexities and requirements of the device.

- Each Device Package contains a mandatory **Device Description (EDD)**, which acts as the information model of the device and describes the device data and type. This information is interpreted by the server. The mandatory Business Logic element outlines the rules for accessing the device data and any dependencies. It can be used to define if and how the data may be viewed. This information is interpreted by the server.
- Optional **User Interface Plug-Ins** are user-defined software components that define special device functions/application information and user interfaces to run on the client.
- **Attachments** are also optional and include things like product manuals, images, and electronic certifications.

Device Definition, Business Logic and User Interface Description are all based on EDDL, whereas the User Interface Plug-In is based on FDT. Device vendors need only deliver Device Packages instead of several device descriptions and FDT DTMs. Additional attachments, such as manuals and protocol specific files, may be included within the Device Package if necessary.
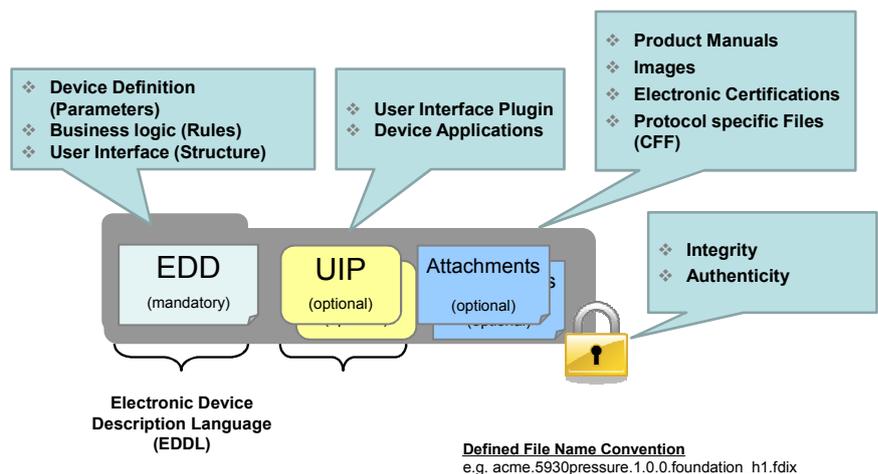
EDDL Harmonization

While EDDL is a standard technology, the different protocols that utilized the technology each employed their own specific version of EDDL. Suppliers developing devices for PROFIBUS, HART, and FOUNDATION fieldbus had to deal with slightly different device descriptions for each protocol. To achieve a single FDI standard, it was clear that a single harmonized EDDL needed to be created, while preserving backwards compatibility with the installed base. This was one of the first activities undertaken by FDI Cooperation and was accomplished early in 2012.

- Device Definition (Parameters)
- Business logic (Rules)
- User Interface (Structure)

- User Interface Plugin
- Device Applications

- Product Manuals
- Images
- Electronic Certifications
- Protocol specific Files (CFF)

- Integrity
- Authenticity

EDD (mandatory)   UIP (optional)   Attachments (optional)

Electronic Device Description Language (EDDL)

Defined File Name Convention
e.g. acme.5930pressure.1.0.0.foundation_h1.fdix

FDI DEVICE PACKAGE

Seamless Compatibility for Devices across Multiple Protocols

Most potential FDI users have a combination of FOUNDATION fieldbus, HART, and PROFIBUS networks in their plants. FDI gives them the opportunity to manage information coming from these devices in a single environment. FDI will be fully compatible with FOUNDATION fieldbus devices, and will fully support existing DD4 and DD5 libraries. For HART devices, FDI will provide full support of existing DD libraries including FMS, FM6, and FM8. For PROFIBUS, backward compatibility will be provided through a new tokenizer tool.

FDT Interoperability

Interoperability with existing technologies such as FDT is a requirement for FDI from both the end user and supplier perspective. The FDT Group and FDI have worked together to ensure that the FDI User Interface Plugins (UIP) have similar characteristics to the FDT DTM User Interface (UI) component. This allows FDI Device Packages to be processed in two system architectures – one purely FDI host and one FDT-based FDI host.

EDDL Interoperability

FDI incorporates EDDL Device Descriptions and is fully compatible with the installed base of intelligent devices that use a previous version of EDDL technology. The EDD Engine supports the entire language scope of EDD in a multiprotocol manner and is backward compatible with existing EDD formats. No changes will have to be made to the installed base of FOUNDATION fieldbus, HART, or PROFIBUS devices to take advantage of FDI host applications.

Common Development Tools for FDI Device Packages and Hosts

Since devices that are compatible with FDI will be developed for multiple protocols such as FOUNDATION fieldbus, HART, and PROFIBUS, common development tools must also be made available to ensure consistency and conformance of all these devices to the FDI standard. FDI is developing an **Integrated Development Environment (IDE)** that will help device manufacturers create device packages for FOUNDATION fieldbus, HART, PROFIBUS and PROFINET devices. The IDE has four components:

- EDDs are created with the help of an editor and converted to the encoded file format by means of "tokenizing" (the binary coding of an EDD).
- The encoded EDD, the UIP developed using Visual Studio, and the attachments are combined to form an FDI Device Package.
- A runtime environment (reference host) runs the FDI Device Packages for tests and debugging.
- The test engine is used to run FDI Device Package conformance tests automatically.

FDI Cooperation LLC will also provide protocol independent standard host software components. Host system manufacturers implement FDI Host Components for device management tools, asset management tools, and process automation systems. EDD Engine (interpreter), UID Renderer and UIP Hosting components ensure that an FDI Device Package behaves in the same way across various systems.

## Registration and Conformance Testing

As we know at the Fieldbus Foundation, proper testing and registration is important to ensure that the device you are purchasing is interoperable and conforms to the specification for which it was built. FDI Device Packages created by device manufacturers will be certified and registered by their respective technology foundation. For example, FDI packages embedded in FOUNDATION fieldbus devices will be registered and tested by the Fieldbus Foundation. HART devices will be tested and registered by the HART Communication Foundation, and PROFIBUS and Profinet devices will be tested and registered by PROFIBUS International.

FDI Cooperation Project Status

To date, FDI Cooperation has identified a complete set of use case analyses encompassing all facets of plant operations from start-up and commissioning to ongoing maintenance activities and plant operations. The group has drafted an FDI architecture concept that meets the needs of each technology as they are migrated to a common standard.

Recent FDI Cooperation activities have focused on fulfilling a functional specification detailing how the benefits of EDDL, FDT, and OPC UA will be combined; common design and test tools; a common binary format; and a common EDDL interpreter across FOUNDATION fieldbus, HART and PROFIBUS protocols. The completion of EDDL harmonization facilitates the harmonization between EDDL and FDT technologies – one of the key goals of FDI.

Validation of the technical specifications is underway prior to the release of the final FDI functional specification and technical specification. Conformance tests are currently being developed to ensure compliance to the new specification by host and device suppliers.
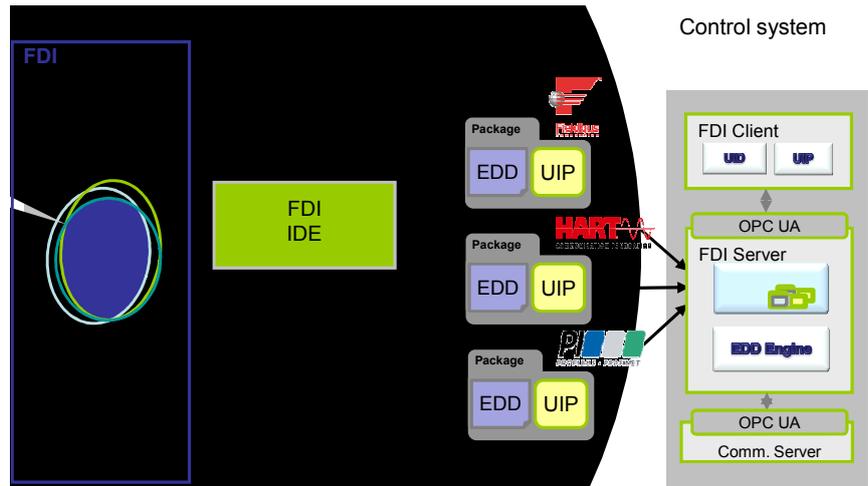
HARMONIZED EDDL WAS ESSENTIAL FOR DEVELOPING THE FDI DEVICE PAKCAGE

In November 2011 at the NAMUR meeting in Germany, FDI device packages were used for the first time to integrate FOUNDATION fieldbus, HART and PROFIBUS field devices from various manufacturers within a process control system. Typical applications, such as parameter assignment, configuration, diagnostics, and maintenance were demonstrated. The purpose of the working prototype was to verify the FDI concepts, apply the standard host components in a system context, and demonstrate FDI functionality.

The first draft of the FDI specification has been published. The next steps of the project include completion of:

- Conformance test concepts
- Validation and review of the FDI specifications within the foundations, and
- FDI standard host components, such as EDD engine, the User Interface (UI) engine by FDI Cooperation.

The common solution for field device integration is coming to fruition. The close collaboration between the FDI Cooperation members will continue until FDI is brought to market and has become an established, adopted standard across the global automation community.

More Information and Resources

You can get more information about FDI at the FDI web site (http://www.fdi-cooperation.com). The web site includes many resources from articles and white papers to presentations and a schedule of upcoming industry events where you can learn more about FDI. You can also email the Fieldbus Foundation for more information about FDI at marketing@fieldbus.org.
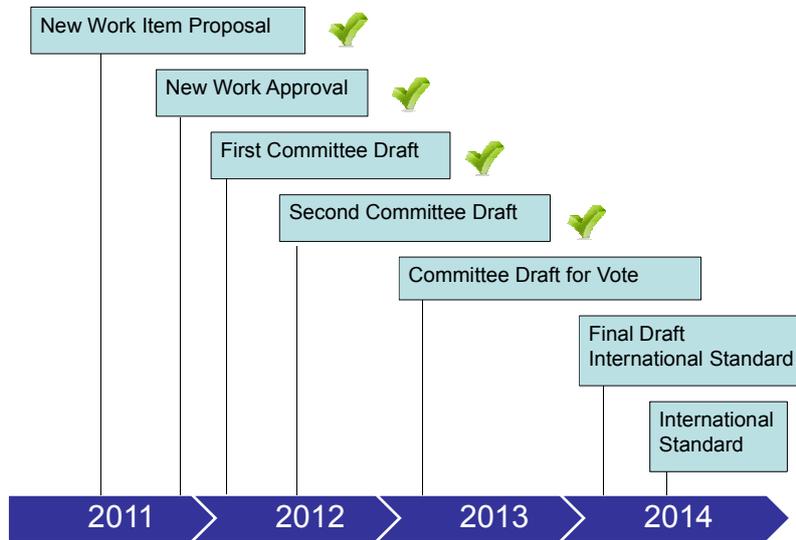
FDI COOPERATION PROJECT TIMELINE FOR IEC STANDARDIZATION