End users have struggled with different forms of device integration technology over the years, but the Field Device Integration (FDI) effort aims to rationalize the world’s 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 making the best use of their applications instead of worrying about how everything will connect together. The initiative will also mean reduced development costs for device and system suppliers.

**History of FDI**

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 know how both EDDL and FDT have evolved and why we need FDI today. Major automation suppliers use EDDL technology to describe the information that is accessible in intelligent field devices. Electronic Device Descriptions (EDDs) are available for millions of devices currently installed in the process industry. The technology is also employed by the major process control system 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 Communication Foundation and PROFINET International.

Virtually every vendor for 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 enables you to 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. It also supports automated procedures or wizards with built-in “method calls.”

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 PROFINET International. The OPC Foundation joined the group in 2004.

Developed and managed by the FDT Group, FDT technology 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. CommDTMs connect to the software communication component. They provide a unified structure for accessing device parameters, configuring and operating devices, and diagnosing problems.

The strength of FDT/DTM lies with its ability to interface with devices and process a high level of diagnostic information. Its key features are independence from any communication protocol and the software environment of the host system. The technology allows any FDT-enabled device to be accessed from any compliant FDT host using any field communication protocol.

**Tale of two technologies**

In many ways, EDDL and FDT are both competing and complementary technologies. Regardless of any level of overlap that may exist between the two solutions, 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 factors were powerful arguments for some kind of rationalization of EDDL and FDT technology. Indeed, they were the impetus for creation of the FDI effort.

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 FDI effort was announced in 2007 at the Interkama/Hannover trade fair. It originally 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 the process industries across all host systems and devices — as well as 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 recommendation 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.

**Industry cooperation**

In September 2011, a new joint company, FDI Cooperation LLC (a limited liability company under U.S. law), was formed. A board of managers that...
Field Device Integration — A Look Ahead

includes representatives from the Fieldbus Foundation, FDT Group, HART Communications Foundation, OPC Foundation and PROFINET IEC 62541. It is developing a solution that is:

- 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

Project scope

FDI Cooperation LLC promises to address key requirements of both the end user and supplier communities, both of which are seeking a single solution for management of information from a wide range of intelligent devices. It 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 with the advantages of the structured OPC UA standard IEC 62541. It 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 international standard
- Accessible 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 ranging from simple configuration to complex management of the most sophisticated field devices, and 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 devote their efforts and resources to a single technology rather than supporting both FDT and EDDL. Suppliers will be able to concentrate 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.

Expanded vision

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. The organization 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

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 EDD acting as the information model of the device and describing 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 also 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 items such as 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 DDs 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 it each employed their own specific version of EDDL. Suppliers developing devices for PROFIBUS, HART, and FOUNDATION fieldbus had to deal with slightly different DDs 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 LLC and was accomplished early in 2012.

Protocol compatibility

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 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, backwards compatibility will be provided through a new tokenizer tool.

Full interoperability

Interoperability with existing technologies such as FDT is a requirement for FDI from both the end user and supplier perspectives. The FDT Group and FDI have worked together to ensure that the FDI User Interface Plug-ins (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.

FDI incorporates EDDL DDs and is fully compatible with the installed base of intelligent devices that use previous versions of EDDL technology. The EDD Engine supports the entire language scope of EDD in a multi-protocol manner and is backwards 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 tools

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 suppliers create Device Packages for Foundation fieldbus, HART, PROFIBUS and PROFINET instruments. The IDE has four components:

- EDDs created with the help of an editor and converted to the encoded file format by means of “tokenizing” (the binary coding of an EDD).
- Encoded EDD, the UIP developed using Visual Studio, and the attachments combined to form an FDI Device Package.
- Runtime environment (reference host) running the FDI Device Packages for tests and debugging.
- Test engine used to automatically run FDI Device Package conformance tests.

FDI Cooperation, LLC will also provide protocol-independent standard host software components. Host system suppliers 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.

In November 2013, FDI Cooperation, LLC announced the first public release of the FDI specification and a demo of the FDI developer toolkits,
both of which will make it possible for automation suppliers to prepare for developing products and host systems compatible with FDI. As part of the release, the FDI specification and the latest EDDL specifications were handed over to the IEC for the Committee Draft for Vote in the international standardization process. FDI will be included in the emerging standard IEC 62769.

Registration testing

As we know at the Fieldbus Foundation, proper testing and registration is important to ensure that a device 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, device 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.

Current status

To date, FDI Cooperation LLC has identified a complete set of use case analyses encompassing all facets of the plant from start-up and commissioning to ongoing maintenance activities and 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 the 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.

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 devices from various suppliers 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 respective foundations
• Finalization of FDI standard host components, such as the EDD engine and UI engine

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

Learn more

Additional information about FDI is available at the FDI Cooperation LLC web site at www.fdi-cooperation.com. Available resources include articles, white papers and presentations, as well as a schedule of upcoming industry events.

For other inquiries, email the Fieldbus Foundation at marketing@fieldbus.org.