IEC 62769-6

Edition 1.0 2015-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Field Device Integration (FDI) – Part 6: FDI Technology Mapping

Intégration des appareils de terrain (FDI) – Partie 6: Mapping de technologies FDI

IEC 62769-6:2015-05(en-fr)

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FIELD DEVICE INTEGRATION (FDI) –

Part 6: FDI Technology Mapping

FOREWORD

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The text of this standard is based on the following documents:

CDV	Report on voting
65E/349/CDV	65E/426/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62769 series, published under the general title *Field Device Integration (FDI)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

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a) Method for the Supplying and Installation of Device-Specific Functionalities, see Patent Family DE10357276;

b) Method and device for accessing a functional module of automation system, see Patent Family EP2182418;

c) Methods and apparatus to reduce memory requirements for process control system software applications, see Patent Family US2013232186;

d) Extensible Device Object Model, see Patent Family US12/893,680.

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FIELD DEVICE INTEGRATION (FDI) –

Part 6: FDI Technology Mapping

1 Scope

This part of IEC 62769 specifies the technology mapping for the concepts described in the Field Device Integration (FDI) standard. The technology mapping focuses on implementation regarding the components FDI Client and User Interface Plug-in (UIP) that are specific only to the workstation platform as defined in IEC 62769-4:2015, Annex E.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62541 (all parts), *OPC Unified Architecture*

IEC 61804 (all parts), *Function blocks (FB) for process control*

IEC 62769-1, *Field Device Integration (FDI) – Part 1: Overview*

NOTE IEC 62769-1 is technically identical to FDI-2021.

IEC 62769-2, *Field Device Integration (FDI) – Part 2: FDI Client*

NOTE 1 IEC 62769-2 is technically identical to FDI-2022.

NOTE 2 IEC 62769-2 is technically identical to FDI-2023.

IEC 62769-4:2015, *Field Device Integration (FDI) – Part 4: FDI Packages*

NOTE IEC 62769-4 is technically identical to FDI-2024.

IEC 62769-5, *Field Device Integration (FDI) – Part 5: FDI Information Model*

NOTE 1 IEC 62769-5 is technically identical to FDI-2025.

NOTE 2 IEC 62769-5 is technically identical to FDI-2027.

ISO/IEC 19505-1, *Information technology – Object Management Group Unified Modeling Language (OMG UML) – Part 1: Infrastructure*

ISO/IEC 29500, (all parts) *Information technology – Document description and processing languages – Office Open XML File Formats*

3 Terms, definitions, abbreviated terms, acronyms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62769-1 as well as the following apply.

3.1.1
Application Domain
isolated environment where applications execute

3.1.2
Assembly
reusable, version information providing, and self-describing building block of a CLR application

Note 1 to entry: This note applies to the French language only.

3.1.3
FDI Type Library
assembly that contains the interfaces and data types that are used for the data exchange and interaction between a UIP and an FDI Client

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: This note applies to the French language only.

3.1.4
Global Assembly Cache
machine-wide code cache that stores Assemblies specifically designated to be shared by several applications

3.1.5
Windows Registry
system-defined database in which applications and system components store and retrieve configuration data

3.2 Abbreviated terms and acronyms

For the purposes of this document, the abbreviated terms and acronyms given in IEC 62769-1 as well as the following apply.

CLR	Common Language Run-time
MSI	Microsoft Installer
WPF	Windows Presentation Foundation
UML	Unified Modeling Language

3.3 Symbols

Figures in this document use the graphical symbols according to ISO/IEC 19505 (UML 2.0).

4 Technical concepts

4.1 General

4.1.1 Overview

In 4.1.2, 4.2, 4.3, 4.4, and 4.5, this document describes first the technology base for UIP implementation, the hardware and software environment including the related implementation rules. Clause 4 follows a life cycle (use case) oriented approach.

Subclause 4.6 describes the copy deployment procedures and related implementation rules for the UIP and the FDI Client.

UIP executable instantiation and termination is described in 4.7.

Subclause 4.8 defines the rules about interaction between the FDI Client and the UIP.

Security related definitions are written in 4.9.

The service interface definitions for the FDI Client and the UIP are found in Clause 5.

4.1.2 Platforms

The UIP and FDI Client shall be built upon the Microsoft .NET Framework and executed in the .NET Common Language Run-time.

The minimum set of workstation supported I/O devices is: mouse, keyboard, and color screen resolution of 1024 x 768 pixels.

The following Table 1 lists all the technologies and their editions that are consistent with FDI components.

Table 1 – Technology edition reference

Technology	Standard	Edition
.NET	N/A	CLR4 for UIP Implementation
EDDL	IEC 61804	2014
OPC UA (Parts 1-8)	IEC 62541	2015 (to be published)
Open Packaging Convention	ISO/IEC 29500	2011
Extensible Markup Language (XML)	N/A	W3C, 1.0 (fifth edition)

4.1.3 FDI Type Library

The Device Access Services and the UIP Services can be modeled as .NET interfaces passing .NET data type arguments. These interfaces and data types are used for the data exchange and interaction between the UIP and the FDI Client. For runtime error handling purposes during interface method calls .NET exceptions classes are defined.

The FDI .NET interfaces, data types, and exception classes are defined in a single FDI Type Library. The FDI Type Library is a strong named Assembly. The FDI Type Library is signed with a single unique key. The FDI Type Library shall be installed as part of the FDI Client installation and not with a UIP.

FDI Type Libraries shall not be registered within the Global Assembly Cache.

The FDI Client shall install FDI Library Versions for all Technology Versions that it supports.

The FDI Type Library shall be installed in such way that it is shared between the UIP and the FDI Client.

Figure 1 shows the FDI Type Library structure.

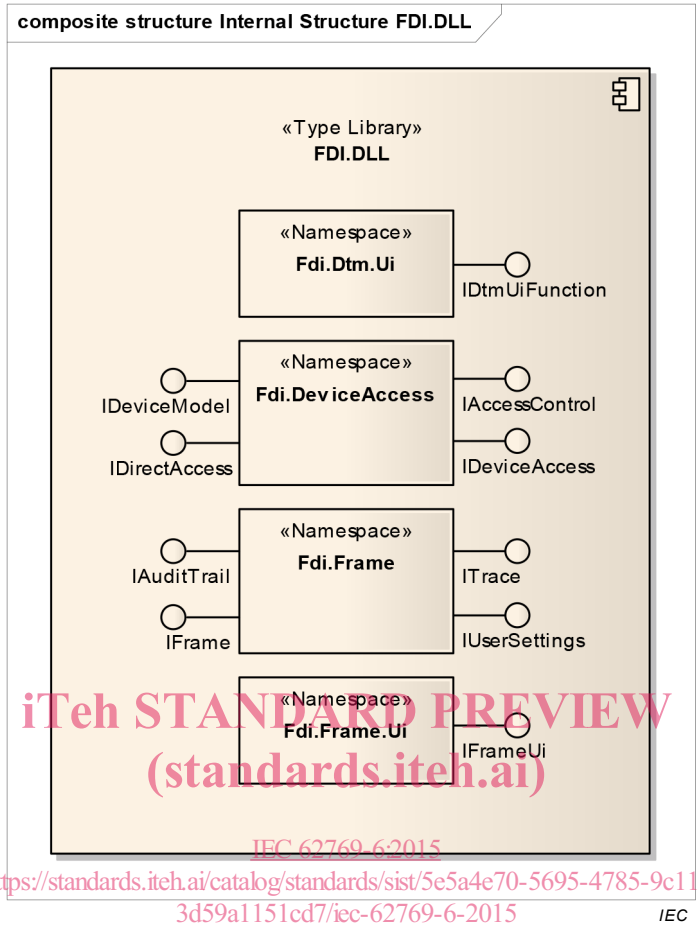

Figure 1 – FDI Type Library structure

NOTE The composite structure diagram shows only the core interfaces that implement the interfaces defined in IEC 62769-2.

4.2 UIP representation

The UIP Variant can contain either a single or multiple runtime modules (.NET Assembly) and their related supplementary files (for example: resource files). The runtime module of the IP Variant is called UIP executable. The supplementary file(s) of the UIP Variant is/are called UIP supplement(s).

UIP supplement(s) is/are stored under (a) subfolder(s) of the UIP executable installation directory

EXAMPLE Examples of UIP supplementary data files include resource files and application configuration data.

The RuntimeId of a UIP Variant shall be ".NET Framework CLR4", see IEC 62769-4.

The UIP Variant shall be self-contained. All UIP required libraries (.NET Assemblies) required by a UIP Variant are stored within the same Folder.

4.3 UIP executable representation

The implementation of the UIP depends on the type of user interface elements that can be embedded into the user interface hosting environment of the FDI Client. UIP shall be

implemented as a .NET `System.Windows.Forms` class `UserControl` or a Windows Presentation Foundation (WPF) `System.Windows.Controls` class `UserControl`.

UIP executables and their required libraries shall have strong names. The signing of a strong named Assembly can be done using a self-generated key.

NOTE The identity of strong named Assemblies consists of a name, version, culture, public key token and digital signature.

UIP executables and their required libraries shall be shipped with file containing the public key in order to enable Assembly verification.

4.4 UIP executable compatibility rules

The UIP component provided version information consists of:

<Major>.<Minor>.<Build Number>.<Revision>

UIP components using the same identity (UipId/IEC 62769-5) that are showing a different value in position <Major> are not compatible with each other. Any other difference showed in the version information between the same UIP component identities means that those UIP component identities are compatible. A newer UIP component is allowed to overwrite an older UIP component without breaking the intended functionality.

The compilation target platform for the UIP shall be “anyCPU”. If this is not feasible the UIP shall be shipped in two variants. One UIP variant shall be compiled for target platform “x86”. The second UIP variant shall be compiled for target platform “x64”. The compilation platform target shall be described in the catalog.xml file which is defined in IEC 62769-4. This catalog.xml file contains an xml element “CpuInformation” that describes the User Interface Plug-in variant. The allowed values that shall be used in the xml element “CpuInformation” are “anyCPU”, “x86” or “x64”.

4.5 Allowed .NET Common Language Run-time versions

4.5.1 General

Specific CLR (Common Language Run-time) versions are released for the execution of software components built with specific .NET Framework versions. The .NET CLR version 4.0 is used to execute software components built with .NET Framework 4.0. .NET Components are built for one CLR version only but can be capable to run also under a newer CLR version.

FDI Clients can be built based on CLR version 4.0 or future versions. An FDI Client has to realize the following situations when starting a UIP.

- When the UIP to be started was built for the same run-time, the UIP can be started in the FDI Client as usual.
- When the UIP to be started was built with another CLR version and is not compiled for the current running CLR version, the FDI Client shall start the UIP in a surrogate process with the adequate CLR version. (More details are described in 4.5.2.)

Taking this behavior in account, a UIP shall be developed for CLR version 4.0 or any future version. In case the CLR versions do not match, the UIP shall be started in a separate process. The UIP will then not be displayed as an integrated module within the FDI Client. It is up to the FDI Client to realize the surrogate process.

4.5.2 CLR compatibility strategy

In the future, FDI Clients and UIPs will be permitted to be built on different incompatible versions of the CLR.

If an FDI Client detects that a UIP requires a CLR that is not compatible with the FDI Client, the FDI Client can use a proxy class that enables interaction with the UIP built using a different version of the CLR.

The FDI Client loads a proxy UIP executable, creates an instance of the proxy class, and delegates the execution of the UIP to this proxy. The proxy starts a process with the required CLR and executes the UIP in this surrogate process. The proxy classes provide the standard FDI interfaces. The FDI Client can use these interfaces to interact with the UIP executed in the surrogate process.

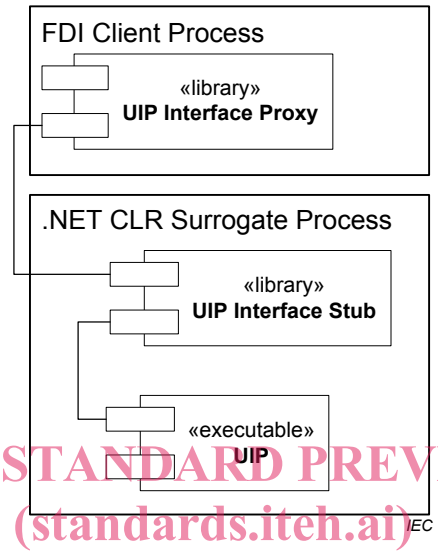

Figure 2 – .NET surrogate process

4.5.3 How to identify the .NET target platform of a UIP

The .NET target platform CLR version information for which a certain Assembly is compiled can be extracted by means of .NET Framework library functions (see Figure 3).

```
clrVersion = Assembly.LoadFrom(<Assembly Path>).ImageRuntimeVersion;
```

IEC

Figure 3 – Identification of Run-time Version

NOTE The Visual Studio[1] 2008 and 2010 IDE allow developers to select the .NET Framework target. The selection of a .NET Framework target older than the base for the current Visual Studio IDE automatically creates a configuration file listed as “app.config” within the solution explorer. This file only reflects the current complier setting. The compiler does not read that file.

4.6 Installing UIP

The FDI Server imports the UIP from an FDI Package.

The UIP installation is done per file copy only. The UIP executable shall not be registered within the Global Assembly Cache. The UIP is installed within a folder structure, which is

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1 Visual Studio is the trade name of Microsoft Corporation. This information is given for the convenience of users of this part of IEC 62769 and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

called the UIP folder structure. The FDI Client shall manage the UIP folder structure. The UIP folder structure shall separate the UIP Variants from each other in order to avoid file name conflicts. UIP executables shall be installed to a path that allows browse read and write access.

Since the FDI Client manages the folder structure the UIP shall not perform any access to an absolute path. Any file access shall be done relative to the installation root of the UIP.

According the version management described in IEC 62769-4, the coexistence of major version changes of UIP of the same type shall be supported. This shall be done by installing a newer UIP into a separate folder. The “strong-name” rule ensures that related Assemblies can coexist during runtime.

The FDI Client implementation ensures that UIP deployment works independently from current user credentials. (See the NOTE below.)

NOTE Certain operating system managed folders require specific access rights, for example, modifications in folder “Program Files” require “Administrator” rights. The Windows operating system provides several means to allow an application running with restricted user rights, to execute actions with administrator privileges transparent to the user, for example, special restriction handling for identified directories, services with administration rights, executables that are configured to automatically run with administration rights. The alternative is to copy UIP executables into folders writeable for “normal” users.

4.7 UIP Lifecycle

4.7.1 General

The UIP state machine, outlined in IEC 62769-4, is composed of the Loaded, Created, Operational, Deactivated and Disposed states. The mechanisms affecting state changes are described in 4.7.

After the FDI Client has stored the UIP executable on the FDI Client the FDI Client loads the UIP Assemblies dynamically into the memory and executes the related logic by calling the corresponding FDI specified interface functions.

Subclause 4.7 describes rules about how the FDI Client shall activate and deactivate the UIP.

4.7.2 UIP Assembly activation steps

4.7.2.1 Load

The FDI Client shall load the UIP executables by using the LoadFrom mechanism. The .NET framework provides System.Reflection.Assembly.LoadFrom for this purpose:

The LoadFrom mechanism behaves as follows.

- LoadFrom loads the Assembly addressed with the file path and also the referenced Assemblies located within same directory. The argument string assemblyFile shall contain the file name of the UIP executable. The file name of the UIP executable represents the StartElementName described in IEC 62769-4.
- If an Assembly is loaded with LoadFrom, and later an Assembly in the “load context” attempts to load the same Assembly by display name, then this load attempt fails.
- If an Assembly with the same identity is already loaded (for example, by another UIP), then LoadFrom returns the Assembly that has been loaded before, even if a different file path was specified. Even a different file name does not matter. Only the identity of the Assembly is relevant.
- If an Assembly is loaded with LoadFrom, and the probing path includes an Assembly with the same identity (for example, in the Global Assembly Cache or an application directory), then this Assembly is loaded, even if a different file path was specified.