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Field device integration (FDI) – Part 1: Overview

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FIELD DEVICE INTEGRATION (FDI) –

Part 1: Overview

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62769-1:2015. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62769-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) support for generic protocol extension for faster adoption of other technologies;
b) digital signature now include trusted timestamping for long term validation of FDI Package;
c) support of new protocols.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65E/758/FDIS	65E/768/RVD

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

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC ~~62657~~ 62769 series has the general title *Field Device Integration (FDI)* and the following parts:

– Part 1: Overview
– Part 2: FDI Client
– Part 3: FDI Server
– Part 4: FDI Packages
– Part 5: FDI Information Model
– Part 6: FDI Technology Mapping
– Part 7: FDI Communication Devices
– Part 100: Profiles – Generic Protocol Extensions
– Part 101-1: Profiles – Foundation Fieldbus H1
– Part 101-2: Profiles – Foundation Fieldbus HSE
– Part 103-1: Profiles – PROFIBUS
– Part 103-4: Profiles – PROFINET
– Part 109-1: Profiles – HART and WirelessHART
– Part 115-2: Profiles – Protocol-specific Definitions for Modbus RTU
– Part 150-1: Profiles – ISA 100.11a

~~The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning~~

~~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 1: Overview

1 Scope

This part of IEC 62769 describes the concepts and overview of the Field Device Integration (FDI) specifications. The detailed motivation for the creation of this technology is also described (see 4.1). Reading this document is helpful to understand the other parts of this multi-part standard.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 61804 (all parts), *Function blocks (FB) for process control and Electronic Device Description Language (EDDL)*~~

~~*IEC 62453 (all parts), Field device tool (FDT®) interface specification*~~

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

IEC TR 62541-1, *OPC Unified Architecture – Part 1: Overview and concepts*

IEC 62541-3, *OPC Unified Architecture – Part 3: Address Space Model*

IEC 62541-4, *OPC Unified Architecture – Part 4: Services*

IEC 62541-5, *OPC Unified Architecture – Part 5: Information Model*

IEC 62541-100, *OPC Unified Architecture – Part 100: Device Interface*

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

~~NOTE IEC 62769-2 is technically identical to FDI-2022[4].~~ [1]

~~IEC 62769-3, *Field Device Integration (FDI) – Part 3: FDI Server*~~

~~NOTE IEC 62769-3 is technically identical to FDI-2023. [5]~~

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

~~NOTE IEC 62769-4 is technically identical to FDI-2024. [6]~~

~~IEC 62769-5:2015, *Field Device Integration (FDI) – Part 5: FDI Information Model*~~

~~NOTE IEC 62769-5 is technically identical to FDI-2025. [7]~~

~~[1] Numbers in square brackets refer to the Bibliography.~~

~~IEC 62769-6:2015, *Field Device Integration (FDI) – Part 6: FDI Technology Mapping*~~

~~NOTE IEC 62769-6 is technically identical to FDI-2026. [8]~~

~~IEC 62769-7, *Field Device Integration (FDI) – Part 7: FDI Communication Devices*~~

~~NOTE IEC 62769-7 is technically identical to FDI-2027. [9]~~

~~ISO/IEC 11578, *Information technology – Open Systems Interconnection – Remote Procedure Call (RPC)*~~

3 Terms, definitions, abbreviated terms and ~~acronyms~~ conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions given in IEC TR 62541-1, IEC 62541-3, IEC 62541-4, IEC 62541-5, IEC 62541-100, as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
Field Device Integration
FDI
device integration and device management technology, combining base concepts and technology aspects of the Electronic Device Description Language (EDDL) according to IEC 61804 and Field Device Tool (FDT®) according to IEC 62453, as well as in IEC 62541-1 (OPC UA)

Note 1 to entry: The combination of those different proven technologies ensures a secure life cycle and the ability to address all challenges of Device Integration and Device Management in a scalable manner.

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

~~Note 3 to entry: This note applies to the French language only.~~

~~Note 4 to entry: This note applies to the French language only.~~

3.1.2
Action
procedure that requires collaboration between an FDI Client and an FDI Server

3.1.3
Business Logic
descriptive element of an FDI Package that specifies the device-specific behavior and/or mapping logic for a Nested Communication

3.1.4
Business Logic Interface
interface through which Business Logic is integrated with the Information Model

3.1.5
Communication Device
physical device that provides access to networks and devices

Note 1 to entry: Gateways and routers are examples of communication devices.

3.1.6
Connection Point
logical representation of a connection of a communication end point to a communication network

3.1.7
Device Access Services
set of services through which a User Interface Plug-in accesses the Information Model of an FDI Server

3.1.8
Device Definition
required element of an FDI Package that provides the core definition of a device

3.1.9
Device Instance
representation of a specific device in the Information Model of an FDI Server

3.1.10
Device Tool
standalone application that contains both an FDI Client and an FDI Server

3.1.11
Device Topology
arrangement of communication networks and devices that forms a network

3.1.12
Device Type
representation of a type of device in the Information Model of an FDI Server

3.1.13
FDI Client
software component that uses the Information Model, interprets user interface descriptions, and hosts user interface plug-ins

3.1.14
FDI Communication Server
OPC UA server that is used by an FDI Server to access non-native networks

3.1.15
FDI Package
collection of components that provide all the information necessary to integrate a type of device into a system

3.1.16
FDI Server
software component that implements the Information Model, executes Business Logic, and communicates with device via Native Communication and/or Nested Communication

3.1.17
FDI Technology Version
version number that identifies to a specific revision of the overall FDI technology

3.1.18
Hosting Services
set of services through which a User Interface Plug-in interacts with an FDI Client

3.1.19
Information Model
set of objects, variables, and methods exposed by an FDI Server

3.1.20
Modular Device
device that is composed of one or more subdevices

3.1.21
Native Communication
communication with devices that are an integral part of the system

3.1.22
Nested Communication
communication with devices through a series of communication devices

3.1.23
Offline Data
device information maintained by an FDI Server that is stored in an FDI Server-specific database

3.1.24
Online Data
device information maintained by an FDI Server that is retrieved from a physical device

3.1.25
User Interface Services
UI Services
set of services through which a User Interface Plug-in accesses the operating system

3.1.26
Platform User Interface Services
platform UI services
user interface services provided natively by the operating system

3.1.27
User Interface Description
UID
descriptive element of an FDI package that is used by an FDI Client to render user interface

3.1.28
User Interface Description Interpreter
UID interpreter
software component in an FDI Client that renders user interface descriptions and invokes actions

3.1.29
User Interface Plug-In
UIP
executable element of an FDI package that is executed by an FDI Client

3.1.30
User Interface Plug-In ~~UIP~~ Services
UIP services
set of services through which an FDI Client interacts with a user interface plug-in

3.2 IEC TR 62541-1 terms (OPC UA)

For the purposes of this document, the following terms and definitions given in IEC TR 62541-1 apply.

AddressSpace
Attribute
Client
Method
Node
NodeClass
Notification
Object
ObjectType
Reference
ReferenceType
Server
Service Set
Session
Subscription
Variable

3.3 IEC 62541-3 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-3 ~~(OPC UA) and the following~~ apply.

Aggregates
ArrayDimensions
AuditEvent
AuditUpdateMethodEvent
BrowseName
ByteString
DataType
DataVariable
Folder
HasComponent
HasProperty
HasSubType
HasTypeDefinition
ModellingRule
NodeId
Property
UserAccessLevel
UserExecutable
Value
ValueRank

3.4 IEC 62541-4 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-4 ~~(OPC UA)~~ apply.

AddReferences

Browse

BrowseNext

Call

CreateSession

NodeManagement

Read

Request Header

Response Header

StatusCode

TranslateBrowsePathsToNodeIds

UserIdentityToken

Write

3.5 IEC 62541-5 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-5 apply.

BaseObjectType

PropertyType

3.6 IEC 62541-100 (OPC UA for Devices) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-100 apply.

Block

Device

DeviceType

Parameter

3.7 Abbreviated terms ~~and acronyms~~

DTM	Device Type Manager
EDD	Electronic Device Description
EDDL	Electronic Device Description Language
FB	Function blocks
FDI	Field Device Integration
FDT®[2]	Field Device Tool (see IEC 62453)
GUI	Graphical User Interface
n/a	Not applicable

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2 FDT logo is a trade name of the non-profit organization FDT Group AISBL. 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 trade names holder or any of its products. Compliance does not require use of the registered trade name. Use of the trade names requires permission of the trade name holder.

OPC	Open packaging conventions
OPC UA	OPC Unified Architecture (see IEC 62541)
PC	Personal computer
PNO	PROFIBUS Nutzerorganisation e. V. (is a regional organization of the PROFIBUS and PROFINET International consortium)
RPC	Remote Procedure Call
UI	User Interface
UID	User Interface Description
UIP	User Interface Plug-in
UUID	Universally unique identifier
XML	Extensible markup language
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e. V.

3.8 Conventions

Capitalization of the first letter of words beyond those defined in ISO/IEC Directives Part 2 is used in the IEC 62769 series to emphasize an FDI-specific meaning. It is used for the following cases:

- Defined terms
- Names of Services defined in IEC 62769-2
- Names of FDI Package elements defined in IEC 62769-4
- Names of Information Model elements defined in IEC 62769-5

EDD language elements are written with all letters in uppercase.

4 Background

4.1 Motivation

In today's automation systems, field devices from many different suppliers have to be integrated into the system, which results in additional effort for installation, version management and operation of these devices. This challenge is best met with an open and standardized device integration solution.

Two different device integration technologies exist: the Electronic Device Description Language (EDDL) in accordance with IEC 61804 and the Field Device Tool (FDT®) in accordance with IEC 62453. While these technologies take different approaches to solve the problem, there is a lot of overlap between them. This has led to a situation where the technologies compete ~~with each other~~ instead of complementing each other. As a result, system suppliers have taken their positions, device suppliers have had to double their efforts in order to support EDDL and FDT®, and the end users have become frustrated because they want the best of both technologies.

For all parties involved, the ideal solution looks different. System suppliers want to achieve robustness while assuring a high level of technology and platform independence. Device suppliers want to support only one technology instead of two in order to reduce cost and effort, and they want to provide the optimal means for operating their devices. End users want to avoid false investments and therefore demand only one future-proof solution that offers all the advantages of the competing technologies.

4.2 Electronic Device Description Language (EDDL)

The Electronic Device Description Language (EDDL) is a language for describing the behavior of field devices. It enables systems to configure, calibrate, troubleshoot, and operate a field device without any prior knowledge of the device.

Device descriptions written in EDDL describe the capabilities of the field device; it is up to the system to determine how to utilize these capabilities. These device descriptions enable systems to access all the data and properties of all devices, which simplifies the maintenance, support, and operation of the devices. It works well for small handheld applications and large integrated automation systems. It works well for embedded systems and systems running on commercial operating systems.

With EDDL, the device supplier can organize the device's data, properties, and procedures for access by the end user. This provides the system guidance in dynamically creating a user interface for the device. The capabilities of this user interface can vary significantly for different classes of devices, and it can be as simple or complex as the device being described.

In the early 1990s, the first version of EDDL was created and was used to describe HART field devices. In 1996, the EDDL was used to describe FOUNDATION Fieldbus devices. Then in 2000, it was used to describe PROFIBUS devices. All three versions of EDDL can trace their lineage back to the original HART version. Therefore, all three versions are largely the same, with some differences due to differences in the underlying communication protocols. EDDL was standardized first as part of IEC 61804-3 and IEC 61804-4 in March 2004.

4.3 Field Device Tool (FDT®)

FDT® is an interface specification that standardizes the interface between the device software and the systems. It provides independence from the communication protocol and establishes a clear boundary between the software provided by the device supplier and the software provided by the system supplier.

In FDT®, field devices are delivered with a device-specific software component called a Device Type Manager (DTM), which is only functional when used in conjunction with an FDT®-specific environment called a "frame application". A frame application interacts with a DTM through a set of standard FDT® interfaces.

A device supplier can develop a DTM for each of its devices, or it can develop a DTM for a group of devices. A DTM can be used to access Device Parameters, configure and operate the device, and diagnose problems. A DTM can range from a simple Graphical User Interface (GUI) for setting Device Parameters to a highly sophisticated application for performing complex calculations for diagnosis.

DTMs can be nested in order to support Modular Devices. The nesting of DTMs also allows multi-level communication hierarchies to be supported. Devices routed through different bus protocols can be connected through standard interfaces. A device DTM just has to support its own communication protocol. Gateway DTMs that connect to the device DTM handle protocol transformation.

The FDT® specification supports a variety of bus protocols, for example: PROFIBUS, HART, FOUNDATION Fieldbus, Interbus, AS-interface, IO-Link, DeviceNet, and PROFINET IO.

In 1998, the specification phase started in the context of the Zentralverband Elektrotechnik und Elektronikindustrie e. V. (ZVEI). In 1999, completion of the technology was accelerated when the specification was adopted by PROFIBUS Nutzerorganisation e. V. (PNO), which later transferred the rights to the FDT Group AISBL. FDT® was standardardized as IEC 62453-1 in May 2009.

4.4 OPC Unified Architecture (OPC UA)

OPC Unified Architecture (OPC UA) is a platform-independent standard through which various kinds of systems and devices can communicate by sending messages between clients and servers over various types of networks. It supports robust, secure communication that assures the identity of clients and servers and resists attacks.

OPC UA defines standard sets of services that servers can provide, and individual servers specify to clients what service sets they support. The services act on an object model which is managed by the server and discoverable by a client. Information is conveyed using standard and vendor-defined data types, and servers define object models that clients can dynamically discover. Servers can provide access to both current and historical data, as well as alarms and events to notify clients of important changes.

OPC UA can be mapped onto a variety of communication protocols and data can be encoded in various ways to trade off portability and efficiency. Transports and encodings for XML based Web Services as well as a high-performance binary are defined for OPC UA. The abstraction of the OPC UA standard from any particular technology provides future-proofing allowing OPC UA to be mapped onto future technologies.

The integration of system components includes a "how" factor and a "what" factor. The comprehensive set of services provided by OPC UA enables the "how" of system integration. OPC UA also provides the basic building blocks of the "what" of system integration by defining an extensible object model. Other standards bodies, vendors, and end users can extend this object model to achieve a tight integration between system components.

OPC UA is standardized in IEC 62541.

5 Architecture

5.1 Overview

The FDI architecture consists of FDI Packages, FDI Clients, and FDI Servers as shown in Figure 1.

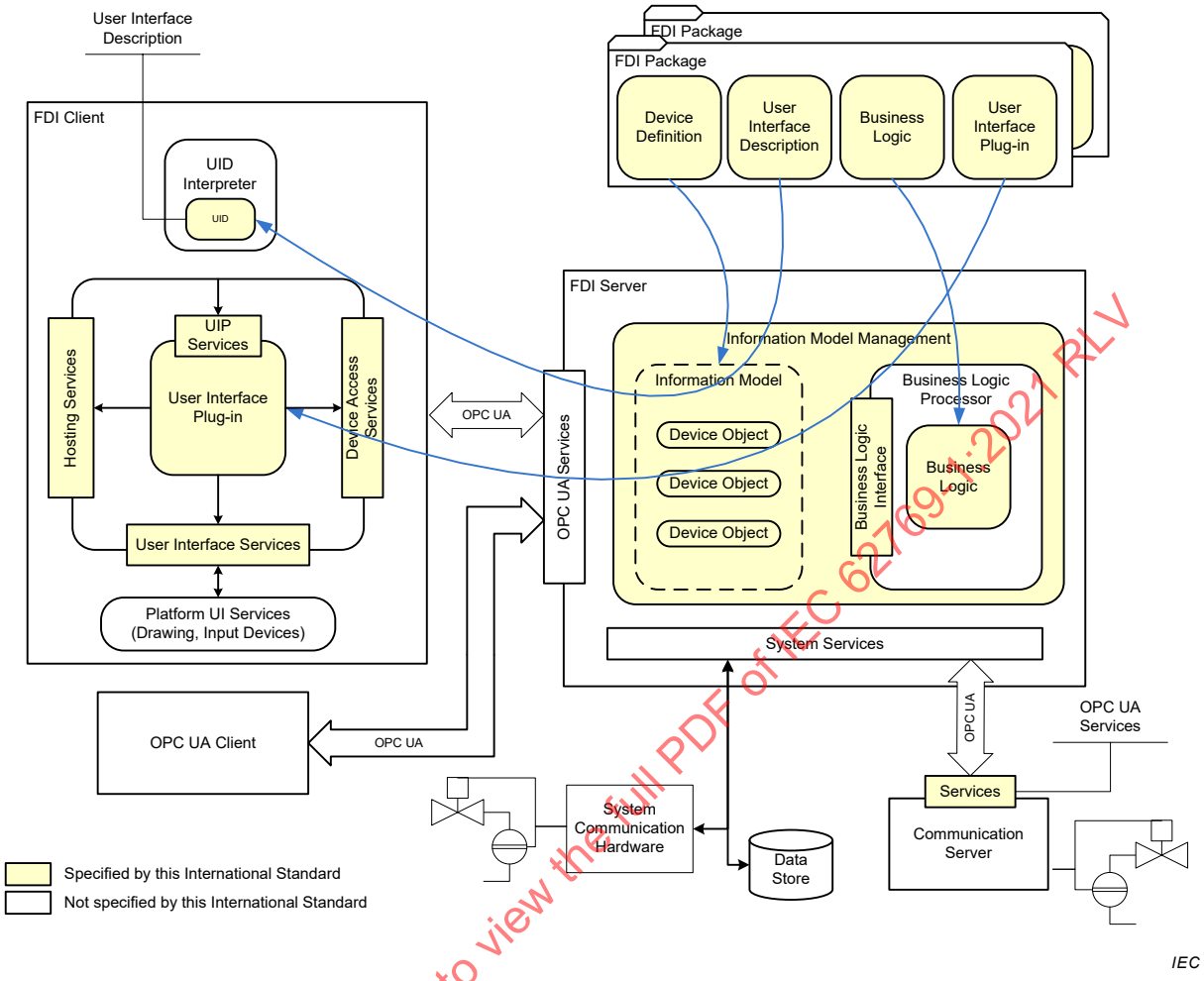

Figure 1 – FDI architecture diagram

5.2 FDI Packages

FDI Packages are the means by which device vendors provide information about their devices to system vendors. FDI Packages collect all of the device information required by a system vendor in one place. FDI Packages are system independent, i.e. device vendors provide the same FDI Package to all system vendors.

An FDI Package includes the following:

- Device Definition – Core definition of the device that is used by an FDI Server to create the Information Model.
- Business Logic – Ensures the integrity of the Information Model.
- User Interface Description – Declarative user interface that is rendered by an FDI Client via a UID Interpreter.
- User Interface Plug-in – Optional programmed user interface that is hosted by an FDI Client.

The Device Definition and Business Logic are used exclusively by an FDI Server. The User Interface Description is processed by the FDI Server and transferred to the FDI Client. User Interface Plug-ins are not processed by the FDI Server, beyond what is necessary to deliver them to the FDI Client.

The Device Definition, Business Logic, and User Interface Description are completely platform independent. User Interface Plug-ins shall be targeted at a specific run-time environment. Distinct User Interface Plug-ins can be developed for different run-time environments, but a specific User Interface Plug-in will only run on a single run-time environment.

The content of an FDI Package is specified in IEC 62769-4.

5.3 FDI Client

FDI Clients interpret and render descriptive user interface contents (UID, Device Parameter values and so on) that are delivered to an FDI Client via the Information Model of an FDI Server in a specified format and through defined services. Interpretation of the EDD portion of an FDI Package however is only done in the FDI Server. In addition, FDI Clients also host User Interface Plug-ins.

The environment for hosting User Interface Plug-ins consists of four sets of services: the Hosting Services, the UIP Services, the User Interface Services, and the Device Access Services.

- The Hosting Services provide the means by which a User Interface Plug-in interacts with the FDI Client.
- The UIP Services provide the means by which an FDI Client can activate, control, and shutdown the User Interface Plug-in.
- The User Interface Services provide the means by which a User Interface Plug-in accesses the operating system specific Platform UI Services, which provide access to the screen, keyboard, mouse, and so on.
- The Device Access Services provide the means by which a User Interface Plug-in accesses the Information Model in an FDI Server.

The behavior of an FDI Client is specified in IEC 62769-2.

5.4 FDI Server

FDI Servers provide FDI Clients access to information about Device Instances and Device Types regardless of where the information is stored, for example, in the device itself or in a data store. This information can be provided via OPC UA services.

The Information Model specifies the entities that can be accessed in an FDI Server, including their properties, their relationships, and the operations that can be performed on them. The Information Model is driven largely by the Device Definitions in FDI Packages. The Information Model is based on the Information Model specified in the OPC UA Devices Specification.

The FDI Server invokes the Business Logic in FDI Packages as entities in the Information Model are accessed. One of the main purposes of the Business Logic is to keep the Information Model consistent.

The Business Logic Interface is the means by which Business Logic is integrated with the Information Model. This interface consists of a set of well-defined Business Logic entry points, which can be used by the Information Model to invoke Business Logic, and a set of well-defined Information Model entry points, which can be used by the Business Logic to access the Information Model.

An FDI Server shall support all elements of an FDI Package.

Some of the information managed by an FDI Server shall be stored persistently. The means by which this data is stored is server-specific.

The behavior of an FDI Server is specified in IEC 62769-3, and the Information Model is specified in IEC 62769-5.

5.5 FDI Communication Server

An FDI Server inherently knows how to communicate with devices via the communication hardware it natively supports. In addition, an FDI Communication Server can be used to extend the devices that the FDI Server can communicate with. An FDI Server communicates with an FDI Communication Server via standard communication services that are specified in IEC 62769-7.

5.6 User Interface tiering

There are three tiers of user interfaces that can be developed using FDI.

The lowest tier is a User Interface Description based user interface. This kind of user interface is completely defined by a User Interface Description. It is the easiest user interface to create, but it also has the most limitations. This kind of user interface is sufficient for relatively simple devices.

The second tier is a User Interface Plug-in based user interface. This kind of user interface is defined via the combination of a User Interface Description and one or more User Interface Plug-ins. This is a more complicated user interface to build since it involves some software development, but it also can produce a more sophisticated user interface. This kind of user interface is required for some complex devices.

The third tier is an FDI Client. An FDI Client may access multiple devices, while User Interface Descriptions and User Interface Plug-ins may only access a single device. This kind of user interface is required when access to multiple devices is required.

5.7 FDI security considerations

FDI is used between components in the operation of an industrial facility at multiple levels: from high-level enterprise management applications accessing device data to low-level direct process control of a device. Such a system may be an attractive target for industrial espionage or sabotage, and may also be exposed to threats through untargeted malware such as worms circulating on public networks. Corrupted device configurations could result in financial losses, affect employee and public safety, or cause environmental damage.

FDI relies on many other systems within the industrial facility. The FDI Clients and Servers are installed on IT systems. Standard communication protocols such as OPC UA and field bus protocols are used for communication between the FDI Clients and the FDI Server as well as between the FDI Server and the devices. Therefore, FDI security should work within the overall Cyber Security Management System (CSMS) of a site. A CSMS typically addresses threats, analyses the security risks and determines what security controls the site needs.

Resulting security controls commonly implement a "defence-in-depth" strategy that provides multiple layers of protection and recognizes that no single layer can protect against all attacks. Boundary protections may include firewalls, intrusion detection and prevention systems, controls on dial-in connections, and controls on media and computers that are brought into the system. Protections in components of the system may include hardened configuration of the operating systems, security patch management, anti-virus programs, and not allowing email in the control network. Standards that may be followed by a site include the IEC 62443 series and IEC TR 62351-10.

The system owner that installs FDI Clients or Servers should analyse its security risks and provide appropriate mechanisms to mitigate those risks to achieve an acceptable level of security.

Developers of FDI Clients and Servers should analyse security threats to the system and implement appropriate countermeasures. The threats and appropriate countermeasures depend on the technologies used for implementation and fall outside the scope of the FDI specification.

5.8 Redundancy

Redundancy is system specific and managed by the automation system. FDI Packages are specified without regard to redundancy. User Interface Descriptions and User Interface Plug-ins have no knowledge about the redundancy of the devices they are associated with.

6 Deployment

6.1 Overview

The FDI specification does not mandate a specific deployment strategy. However, a typical deployment scenario is shown in Figure 2. The shaded boxes correspond to the components described in 5.2, 5.3, 5.4, and 5.5.

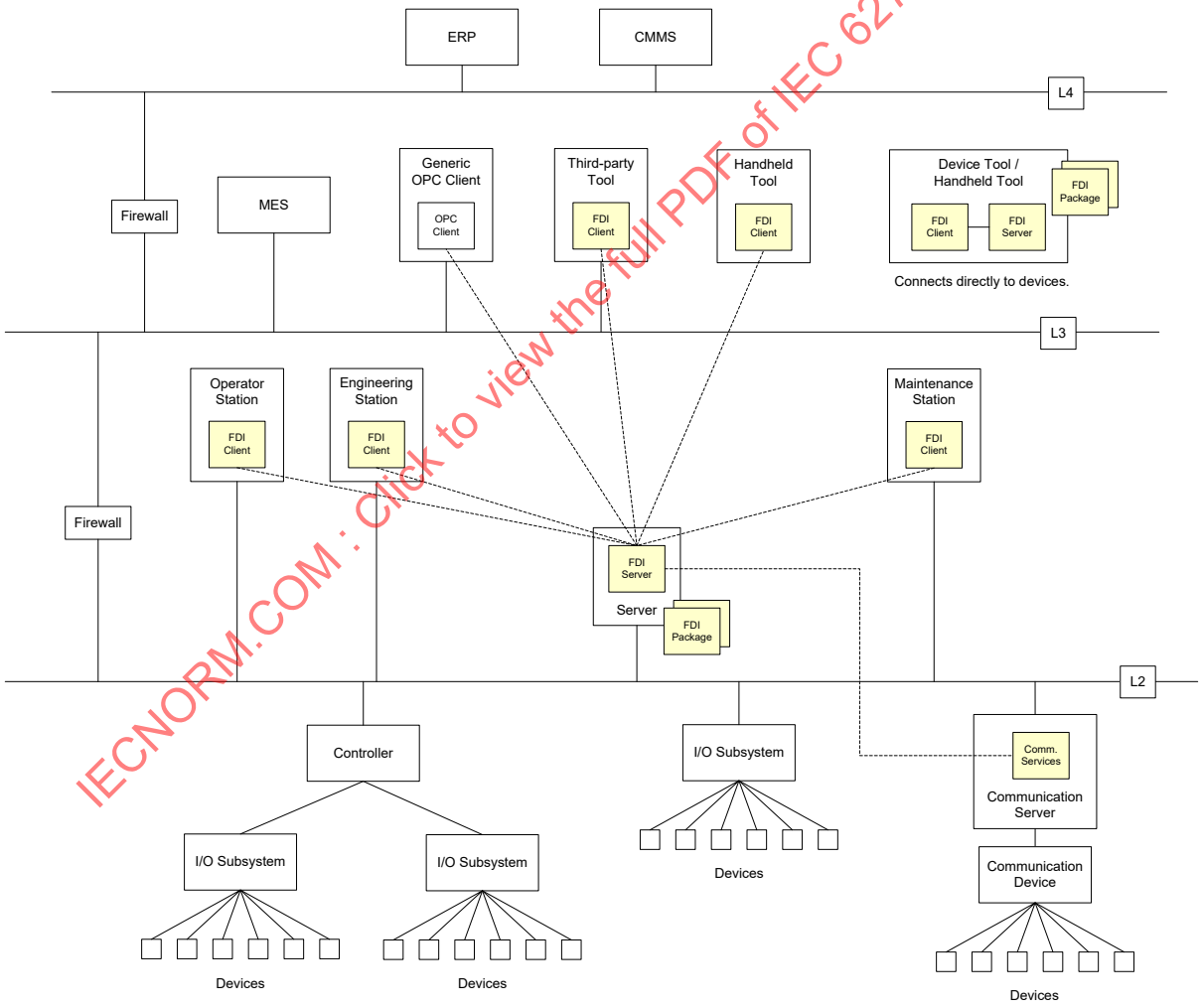

Figure 2 – Typical deployment scenario

6.2 Engineering, operator and maintenance stations

The engineering, operator and maintenance stations are part of an automation system through which users engineer, operate and maintain their plant. One or more FDI Clients can be running on these stations. These FDI Clients are full-featured clients that can interpret User Interface Descriptions and execute User Interface Plug-ins.

6.3 FDI Server

An FDI Server is provided as part of the automation system. FDI Packages are installed on the FDI Server. The FDI Server serves up information from the FDI Packages to the FDI Clients.

The supplier of the automation system can provide both an FDI Server and one or more FDI Clients. These FDI Clients can communicate with the FDI Server through proprietary protocols; however, if the FDI Server supports third-party FDI Clients it shall support OPC UA.

The FDI Server is usually distinct from the servers that provide run-time data to the operator, engineering, and maintenance stations.

6.4 FDI Communication Servers

An FDI Communication Server can be embedded within a Communication Device or can be provided via a separate server as shown in Figure 2.

6.5 Device Tools

A Device Tool is a standalone application that contains both an FDI Client and an FDI Server. The FDI Packages supported by the Device Tool are installed along with the Device Tool.

6.6 Third-party Tools

Third-party Tools are applications that contain an FDI Client and communicate with the automation system's FDI Server. While these tools can be provided by the supplier of the automation system, they are often provided by other vendors.

6.7 Handheld Tools

Handheld Tools are applications running on handheld devices. Handheld Tools can be implemented as a Device Tool, where an FDI Client, an FDI Server, and FDI Packages are installed on the handheld device. Handheld Tools can also be implemented as a third-party tool where only an FDI Client is installed on the handheld device.

6.8 Generic OPC UA Clients

When an FDI Server is an OPC UA Server (see 6.3), generic OPC UA Clients with no knowledge of FDI can connect to the FDI Server. These clients are limited to general access of the Information Model. In particular, the lack of understanding of User Interface Descriptions and User Interface Plug-ins prevents them from rendering an FDI-based user interface.

7 FDI Host

7.1 Overview

FDI Hosts are combinations of FDI Client and FDI Server applications capable of consuming FDI Packages. FDI Hosts are used to access Device data (typically Field Device and Communication Device Parameters) through User Interfaces or directly and may allow the modification of the Device data. FDI Hosts are subjected to FDI Host Conformance Tests.

There are several possibilities of how FDI Hosts may be structured. Subclauses 7.2 and 7.3 list the different FDI Host Variants, Entities and so-called Facets.

7.2 FDI Host Variants and Entities

There are different ways to implement and structure an FDI Host:

- FDI Host (Single User)
  Deployed to a single device (e.g. notebooks, mobile computer). Only a single user can work with the host at a time. Typical examples are so called Device Tools, standalone device management applications and handheld devices.
- FDI Host (Multi User)
  Installed on a single device but potentially also on several devices (e.g. Client/Server architecture). Multiple users are allowed to use the FDI Host at a time. Concurrent access to device data and the concurrent use of User Interfaces is normal to those hosts. Typical examples are distributed host systems and asset management systems.
- FDI Client (OPC UA)
  An FDI aware client application usually provided separately from a DCS (Distributed Control System) and typically provided from a different vendor. This FDI Client application requires an FDI Host supporting the FDI Information Model Facet (see 7.3) and is only possible with FDI Host (Multi User) variant.
- FDI Communication Server
  This server application is used to connect communication hardware to a communication network (as so called network entry point). The FDI Communication Servers are integrated via FDI Communication Packages but the software as such comes separately or is implemented embedded into the communication hardware. The FDI Communication Server requires an FDI Host supporting the FDI Communication Server Facet.

7.3 FDI Host Facets

Optional aspects can be added to FDI Host implementations, extending the host with additional capabilities (see Table 1 and Table 2).

- FDI Information Model Facet
  An FDI Host implementing this facet is required to provide an FDI Information Model as per IEC 62769-5 and to support OPC UA as a communication mechanism between FDI Servers and Client applications. The host therefore allows using FDI Client (OPC UA) applications.
- FDI Communication Server Facet
  The capabilities of this facet allow the FDI Host to use FDI Communication Servers. Those grant access to communication networks, via Communication Devices that can now be integrated into an FDI Host via FDI Communication Packages as per IEC 62769-7 and IEC 62769-4.

Table 1 – FDI Host Variants and possible Facets

FDI Host Variants		Information Model Facet	Communication Server Facet
FDI Host	Single User	—	X
	Multi User	X	X

Table 2 – FDI Host Facets and related FDI Entities

FDI Entities		Information Model Facet	Communication Server Facet
FDI Client (OPC UA)	—	X	—
FDI Communication Server	—	—	X

8 Life-cycle model

8.1 Overview

The FDI life-cycle model defines how different versions of FDI Clients, FDI Servers, FDI Packages, and devices can co-exist within a given system over time. The model is focused on the ability to add FDI Packages to a system without having to update FDI Clients or FDI Servers. The model supports the life-cycle model of devices, which includes adding, upgrading, and replacing devices in a system.

The life-cycle model is based on the following principles.

- Every FDI Client, FDI Server, and FDI Package shall have an FDI version number. This version number shall be the version of the FDI specification to which the client, server, or package was built. The major revision of all clients, servers, and packages in a given system shall be the same.
- If any specification referenced by the FDI specification changes, the revision of the FDI specification shall change.
- The version of the underlying technology shall be independent of the FDI version.
- The FDI version supported by a specific FDI Client, FDI Server, or FDI Package can be queried.
- The version of the underlying technology supported by a specific FDI Client, FDI Server, or FDI Package can be queried. Version queries can be used to determine interoperability and compatibility between FDI Clients, FDI Servers, and FDI Packages.
- The algorithm for associating an FDI Package with a physical device is protocol-specific.

A summary of the FDI life-cycle concept is given in Annex A.

8.2 Identification mechanism

Universally unique identifiers (UUID) shall be used to uniquely identify entities within the FDI, see ISO/IEC 11578.

A UUID is a 16-byte number that is usually expressed as a sequence of 32 hexadecimal digits, displayed in 5 groups separated by hyphens, in the following form:

xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx

The following regular expression more precisely specifies the format of a UUID:

```
^(\{{0,1}[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-
F]{12}\}{0,1})$
```

8.3 Versioning mechanism

8.3.1 Version levels

8.3.1.1 Overview

The following pattern shall be used for all version numbers:

<major release>.<minor release>.<revision>-<build number>

Subclauses 8.3.1.2 to 8.3.1.5 specify the standard behavior when dealing with different versions. Some installations, for example in regulated industries, may require different handling.

8.3.1.2 Major release

Significant changes have been made that are not compatible with previous major releases. The necessity for those changes can be technology motivated, for example, an incompatible change of interfaces. They can also be strategically motivated, for example, the introduction of a new generation of existing elements.

A major release coexists with other major releases of the same entity. The increment of a major release requires the UUID of the affected entity to be changed.

8.3.1.3 Minor release (element upgrade)

A fully backward compatible functional extension has been made, for example, by adding features or functionality. No actions have to be taken to use the updated entity in the existing environment. The entity fully interoperates with already deployed entities that might have lower minor release numbers.

A minor release overwrites an already deployed previous version of the same entity. The increment of a minor version number shall not impact the UUID of the affected entity.

8.3.1.4 Revision (element update)

A fully backward compatible correction or editorial change has been made, i.e. a change that does not include any functional extensions. No actions have to be taken to use the updated entity in the existing environment. The entity fully interoperates with already deployed entities that might have lower revision numbers.

A revision overwrites an already deployed previous version of the same entity. The increment of a revision number shall not impact the UUID of the affected entity.

8.3.1.5 Build number

The build number shall not be exposed to the end user and shall only be used for internal development purposes.

8.3.2 FDI Technology Version

8.3.2.1 General

The FDI technology as such has to be versioned to make sure that all individually developed and provided elements are able to interoperate. The above described versioning mechanisms and principles shall be applied to the FDI Technology Version.

The FDI Technology Version is directly and indirectly influenced by several factors such as interface changes/adjustments, behavior changes/adjustments, and changes of underlying technologies (referenced specifications).

FDI components shall check the FDI Technology Version of connected components or FDI Packages to be consumed to ensure that both have the necessary FDI specific capabilities and are therefore able to interoperate.

An FDI Server, for example, is implemented following a specific FDI Technology Version and therefore supports all FDI Packages following the same version or lower. FDI Clients can typically be connected to FDI Servers that are implemented following the same FDI Technology Version or higher.

The following indicate the FDI Technology Version they support:

- FDI Client (see IEC 62769-2);
- FDI Server (see IEC 62769-3);
- FDI Package (see IEC 62769-4);
- User Interface Plug-in (see IEC 62769-4).

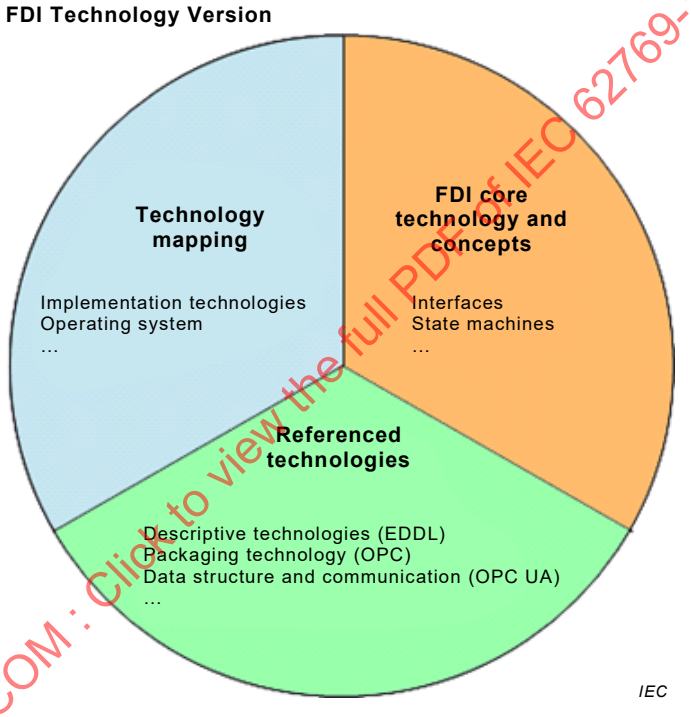

Figure 3 – FDI Technology Version dependencies

Figure 3 shows the influencing factors on the FDI Technology Version which are further described ~~below~~ in 8.3.2.2 to 8.3.2.4.

8.3.2.2 FDI core technology and concepts

The FDI core technology and concepts are defined in all referenced parts of this specification. The specified interfaces, behaviors, state machines, and concepts have to be implemented in accordance with this specification to ensure interoperability of FDI components.

Changes to the specification documents, such as fixing typographical errors, rephrasing to increase the clarity of the document, and other similar changes shall lead to an increment of the revision of the FDI Technology Version.

Changes to the FDI core technology and concepts to improve the technology or to extend the feature set that are fully backward compatible shall lead to an increment of the minor release of the FDI Technology Version.

If non-backward compatible changes are necessary, a new generation of the FDI technology shall be created by incrementing the major release of the FDI Technology Version.

Issue reporting processes concerning FDI core technologies are described in Annex B.

8.3.2.3 Technology mapping

FDI components can be implemented using different implementation technologies and can also run on multiple platforms and operating systems. The details of those technologies are specified in IEC 62769-6.

Updates to mapped technologies shall not lead to an increment of the revision of the FDI Technology Version.

The minor release of the FDI Technology Version shall be incremented when mapped technologies are upgraded without disturbing the interoperability and the proper execution of FDI components, for example, fully backward compatible operating system changes or introduction of additional implementation technologies, platforms, or operating system versions supported.

Incompatible changes or the discontinuing of mapped technologies shall lead to a new generation of FDI and an increment to the major release of the FDI Technology Version.

8.3.2.4 Referenced technologies

The FDI technology references technologies which are used to make possible and support specified functions and concepts of FDI. Those referenced technologies are maintained outside the scope of FDI.

IEC 62769-6 lists the versions of the specifications referenced. Implementation of FDI components using different versions is not permitted.

Updates to referenced technologies shall not lead to an increment of the revision of the FDI Technology Version.

If a referenced technology specification is changed, the new version of the specification shall be adopted into FDI if those changes are fully backward compatible and those improvements also increase the value of FDI. The decision to adopt a new specification version of a referenced technology shall lead to an increment of the minor release of the FDI Technology Version.

Generation changes of referenced technologies shall only be adopted by the FDI if this generation is fully compatible with the previous generation. These changes shall lead to an increment of the minor release of the FDI Technology Version but not to the major release.

Table 3 summarizes influences on the FDI Technology Version.

Table 3 – Summary of influences on the FDI Technology Version

Influence	FDI Technology Version – Version level		
	Revision	Minor	Major
FDI core technology and concepts	Editorial	Extend interfaces Extend functionalities	Generation change by introducing non backward compatible functions or by removing existing aspects
Technology mapping	n/a	Upgrade, fully compatible extensions or generations of mapped technologies	Incompatible changes or discontinuing of mapped technologies
Referenced technologies	n/a	Change if new reference technology fully backward compatible and increasing value	n/a

At least two succeeding major FDI Technology Versions (the latest and the previous generation of FDI) shall be supported in parallel as part of a single FDI Host installation. Support means that FDI Server(s) and FDI Client(s) implement the specifics of the supported technology versions and also accept the import of FDI Packages based on those FDI Technology Versions.

8.3.3 Forward compatibility

8.3.3.1 Version combinations to be handled

FDI Packages are designed to a specific FDI Technology Version that is reflected in the FdiVersionSupported property of the respective FDI Package (see IEC 62769-6). FDI Servers and FDI Clients are also designed to a specific FDI Technology Version.

Table 4 specifies the combinations of FDI Package and FDI Client/Server that shall be supported. Subclauses 8.3.3.2 to 8.3.3.6 describe how each use case shall be handled.

Table 4 – Combinations of Minor Versions that require special handling

Component	FDI Technology Version – Minor version		
	< FDI Package	= FDI Package	> FDI Package
FDI Server	Deployment IM Creation Business Logic Execution User Interface Description	No special handling needed	Rules of backward compatibility, no special handling needed
FDI Client	Visualization (UID) UIP Execution	No special handling needed	Rules of backward compatibility, no special handling needed

8.3.3.2 Deployment

FDI Packages can be deployed to FDI Servers even if the FDI Package's FDI Technology Version is higher than the FDI Server's FDI Technology Version. An automatic blocking mechanism for such FDI Packages is prohibited. During the deployment process the user shall be clearly informed when an FDI Package with a higher version than is supported by the FDI Server is being deployed.

8.3.3.3 Information Model creation

The Information Model nodes are created on the basis of the EDD provided by the FDI Package. If there are EDD constructs that are not known to the FDI Server, the creation of the Information Model shall be cancelled since it cannot be ensured that the FDI Package can be properly imported and that a consistent Information Model can be created. The FDI Server shall provide mechanisms to inform the user about the incompatibility.

8.3.3.4 Business Logic execution

Business Logic is executed by the FDI Server to create nodes in the Information Model and to protect the integrity of the Information Model. If there are EDD constructs (including built-in functions) that are not known to the FDI Server, the execution of the Business Logic shall be cancelled since it cannot be ensured the Business Logic will not endanger the integrity of the Information Model. The FDI Server shall provide mechanisms to inform the user about the incompatibility.

8.3.3.5 User Interface Description/Visualization

User Interface Descriptions are created from EDD information and sent to the FDI Client by the FDI Server. If the FDI Client's UID Interpreter is not able to interpret and/or visualize a part of the UID the user shall be informed, for example, by showing an empty control with an embedded question mark.

8.3.3.6 UIP execution

The forward compatibility of User Interface Plug-ins depends on the forward compatibility capabilities of the underlying implementation technology, see IEC 62769-6.

Annex A
(informative)

FDI life-cycle concept summary

A.1 General

All aspects of the FDI technology supporting a stable and secure life cycle of FDI-based products are essential part of the technology itself. Therefore, the different parts that can be called an FDI life-cycle concept are spread around the different specification parts. Annex A summarizes the most relevant aspects as a reference.

A.2 Life-cycle relevant topics (references)

Table A.1 and Table A.2 provide the life-cycle aspects.

Table A.1 – Life-cycle aspects as part of the FDI technology

Aspect	FDI specification document	Reference
FDI Package Version and dependencies	IEC 62769-4:~~2015~~2020 (FDI Packages)	Clause 6
FDI Packages scale with the described devices	IEC 62769-4:~~2015~~2020 (FDI Packages)	Clause 4
FDI Technology Version	IEC 62769-1:~~2015~~2020 (Overview)	Clause 8
Open and defined Information Model	IEC 62769-5:~~2015~~2020 (FDI Information Model)	Clause 7
Referenced technologies	IEC 62769-6:~~2015~~2020 (FDI Technology Mapping)	Table 1
Supported Firmware revisions of the FDI Package	IEC 62769-4:~~2015~~2020 (FDI Packages)	Annex E
Supported UIP revisions of the FDI Package	IEC 62769-4:~~2015~~2020 (FDI Packages)	Annex E
Technologies directly used by FDI	IEC 62769-6:~~2015~~2020 (FDI Technology Mapping)	Clause 4
Versioning concept for FDI components	IEC 62769-1:~~2015~~2020 (Overview)	Clause 8
FDI Package Registration Certification and signing mechanisms	IEC 62769-4:~~2015~~2020 (FDI Packages)	Clause 7
Typical Use Cases during the life cycle	IEC 62769-4:~~2015~~2020 (FDI Packages)	Annex G

Table A.2 – Life-cycle aspects as part of products and services provided with the FDI technology

Aspect	Product & Service
FDI Package Conformance Testing	FDI Conformance testing services provided by protocol foundations
FDI Host Conformance Testing	FDI Conformance testing services provided by protocol foundations
FDI common EDD binary format	EDDL Encoded File Format specification implemented in FDI Common Host Components
FDI Standard Host components	FDI Common Host Components provided by the protocol foundations
Single registered FDI Package per firmware revision supported	Ensured via FDI Conformance testing services provided by the protocol foundations
FDT® Interoperability	FDI.dll provided by the protocol foundations
Harmonized EDDL	~~IEC 61804~~

Annex B
(informative)

Issue reporting

FieldcommGroup strives to maintain the highest quality standards for its published specifications; hence they undergo constant review and refinement. Readers are encouraged to report any issues here:

http://go.fieldcommgroup.org/support

Bibliography

~~FDI-2021, *FDI Project Technical Specification – Part 1: Overview* <available at www.fdi-cooperation.com>~~

~~FDI-2022, *FDI Project Technical Specification – Part 2: FDI Client* <available at www.fdi-cooperation.com>~~

~~FDI-2023, *FDI Project Technical Specification – Part 3: FDI Server* <available at www.fdi-cooperation.com>~~

~~FDI-2024, *FDI Project Technical Specification – Part 4: FDI Packages* <available at www.fdi-cooperation.com>~~

~~FDI-2025, *FDI Project Technical Specification – Part 5: FDI Information Model* <available at www.fdi-cooperation.com>~~

~~FDI-2026, *FDI Project Technical Specification – Part 6: FDI Technology Mapping* <available at www.fdi-cooperation.com>~~

~~FDI-2027, *FDI Project Technical Specification – Part 7: FDI Communication Devices* <available at www.fdi-cooperation.com>~~

IEC TR 61804-3, *Function blocks (FB) for process control and Electronic Device Description Language (EDDL) – Part 3: ~~Electronic Device Description Language (EDDL)~~ EDDL syntax and semantics*

IEC TR 61804-4, *Function blocks (FB) for process control and electronic device description language (EDDL) – Part 4: EDD ~~interoperability guideline~~ interpretation*

IEC 61804-5, *Function blocks (FB) for process control and electronic device description language (EDDL) – Part 5: EDDL Builtin library*

IEC TR 62351-10, *Power systems management and associated information exchange – Data and communications security – Part 10: Security architecture guidelines*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

IEC 62453 (all parts), *Field device tool (FDT®) interface specification*

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

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

IEC 62769-3, *Field Device Integration (FDI) – Part 3: FDI Server*

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

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

IEC 62769-6, *Field Device Integration (FDI) – Part 6: FDI Technology Mapping*

IEC 62769-7, *Field Device Integration (FDI) – Part 7: Communication Devices*

ISO/IEC 11578, *Information technology – Open Systems Interconnection – Remote Procedure Call (RPC)*

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IEC 62769-1

Edition 2.0 2021-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Field device integration (FDI) – Part 1: Overview

Intégration des appareils de terrain (FDI) – Partie 1: Vue d'ensemble

IEC 62769-1:2021-02(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIELD DEVICE INTEGRATION (FDI) –

Part 1: Overview

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62769-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) support for generic protocol extension for faster adoption of other technologies;
b) digital signature now include trusted timestamping for long term validation of FDI Package;
c) support of new protocols.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65E/758/FDIS	65E/768/RVD

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

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC 62769 series has the general title *Field Device Integration (FDI)* and the following parts:

– Part 1: Overview
– Part 2: FDI Client
– Part 3: FDI Server
– Part 4: FDI Packages
– Part 5: FDI Information Model
– Part 6: FDI Technology Mapping
– Part 7: FDI Communication Devices
– Part 100: Profiles – Generic Protocol Extensions
– Part 101-1: Profiles – Foundation Fieldbus H1
– Part 101-2: Profiles – Foundation Fieldbus HSE
– Part 103-1: Profiles – PROFIBUS
– Part 103-4: Profiles – PROFINET
– Part 109-1: Profiles – HART and WirelessHART
– Part 115-2: Profiles – Protocol-specific Definitions for Modbus RTU
– Part 150-1: Profiles – ISA 100.11a

FIELD DEVICE INTEGRATION (FDI) –

Part 1: Overview

1 Scope

This part of IEC 62769 describes the concepts and overview of the Field Device Integration (FDI) specifications. The detailed motivation for the creation of this technology is also described (see 4.1). Reading this document is helpful to understand the other parts of this multi-part standard.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TR 62541-1, *OPC Unified Architecture – Part 1: Overview and concepts*

IEC 62541-3, *OPC Unified Architecture – Part 3: Address Space Model*

IEC 62541-4, *OPC Unified Architecture – Part 4: Services*

IEC 62541-5, *OPC Unified Architecture – Part 5: Information Model*

IEC 62541-100, *OPC Unified Architecture – Part 100: Device Interface*

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions given in IEC TR 62541-1, IEC 62541-3, IEC 62541-4, IEC 62541-5, IEC 62541-100, as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
Field Device Integration
FDI
device integration and device management technology, combining base concepts and technology aspects of the Electronic Device Description Language (EDDL) according to IEC 61804 and Field Device Tool (FDT®) according to IEC 62453, as well as in IEC 62541-1 (OPC UA)

Note 1 to entry: The combination of those different proven technologies ensures a secure life cycle and the ability to address all challenges of Device Integration and Device Management in a scalable manner.

3.1.2
Action
procedure that requires collaboration between an FDI Client and an FDI Server

3.1.3
Business Logic
descriptive element of an FDI Package that specifies the device-specific behavior and/or mapping logic for a Nested Communication

3.1.4
Business Logic Interface
interface through which Business Logic is integrated with the Information Model

3.1.5
Communication Device
physical device that provides access to networks and devices

Note 1 to entry: Gateways and routers are examples of communication devices.

3.1.6
Connection Point
logical representation of a connection of a communication end point to a communication network

3.1.7
Device Access Services
set of services through which a User Interface Plug-in accesses the Information Model of an FDI Server

3.1.8
Device Definition
required element of an FDI Package that provides the core definition of a device

3.1.9
Device Instance
representation of a specific device in the Information Model of an FDI Server

3.1.10
Device Tool
standalone application that contains both an FDI Client and an FDI Server

3.1.11
Device Topology
arrangement of communication networks and devices that forms a network

3.1.12
Device Type
representation of a type of device in the Information Model of an FDI Server

3.1.13
FDI Client
software component that uses the Information Model, interprets user interface descriptions, and hosts user interface plug-ins

3.1.14
FDI Communication Server
OPC UA server that is used by an FDI Server to access non-native networks

3.1.15
FDI Package
collection of components that provide all the information necessary to integrate a type of device into a system

3.1.16
FDI Server
software component that implements the Information Model, executes Business Logic, and communicates with device via Native Communication and/or Nested Communication

3.1.17
FDI Technology Version
version number that identifies to a specific revision of the overall FDI technology

3.1.18
Hosting Services
set of services through which a User Interface Plug-in interacts with an FDI Client

3.1.19
Information Model
set of objects, variables, and methods exposed by an FDI Server

3.1.20
Modular Device
device that is composed of one or more subdevices

3.1.21
Native Communication
communication with devices that are an integral part of the system

3.1.22
Nested Communication
communication with devices through a series of communication devices

3.1.23
Offline Data
device information maintained by an FDI Server that is stored in an FDI Server-specific database

3.1.24
Online Data
device information maintained by an FDI Server that is retrieved from a physical device

3.1.25
User Interface Services
UI Services
set of services through which a User Interface Plug-in accesses the operating system

3.1.26
Platform User Interface Services
platform UI services

user interface services provided natively by the operating system

3.1.27
User Interface Description
UID
descriptive element of an FDI package that is used by an FDI Client to render user interface

3.1.28
User Interface Description Interpreter
UID interpreter
software component in an FDI Client that renders user interface descriptions and invokes actions

3.1.29
User Interface Plug-In
UIP
executable element of an FDI package that is executed by an FDI Client

3.1.30
User Interface Plug-In Services
UIP services
set of services through which an FDI Client interacts with a user interface plug-in

3.2 IEC TR 62541-1 terms (OPC UA)

For the purposes of this document, the following terms and definitions given in IEC TR 62541-1 apply.

AddressSpace
Attribute
Client
Method
Node
NodeClass
Notification
Object
ObjectType
Reference
ReferenceType
Server
Service Set
Session
Subscription
Variable

3.3 IEC 62541-3 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-3 apply.

Aggregates
ArrayDimensions
AuditEvent
AuditUpdateMethodEvent
BrowseName
ByteString
DataType
DataVariable

Folder
HasComponent
HasProperty
HasSubType
HasTypeDefinition
ModellingRule
NodeId
Property
UserAccessLevel
UserExecutable
Value
ValueRank

3.4 IEC 62541-4 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-4 apply.

AddReferences
Browse
BrowseNext
Call
CreateSession
NodeManagement
Read
Request Header
Response Header
StatusCode
TranslateBrowsePathsToNodeIds
UserIdentityToken
Write

3.5 IEC 62541-5 (OPC UA) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-5 apply.

BaseObjectType
PropertyType

3.6 IEC 62541-100 (OPC UA for Devices) terms

For the purposes of this document, the following terms and definitions given in IEC 62541-100 apply.

Block
Device
DeviceType
Parameter

3.7 Abbreviated terms

DTM	Device Type Manager
EDD	Electronic Device Description
EDDL	Electronic Device Description Language
FB	Function blocks
FDI	Field Device Integration
FDT®[1]	Field Device Tool (see IEC 62453)
GUI	Graphical User Interface
n/a	Not applicable
OPC	Open packaging conventions
OPC UA	OPC Unified Architecture (see IEC 62541)
PC	Personal computer
PNO	PROFIBUS Nutzerorganisation e. V. (is a regional organization of the PROFIBUS and PROFINET International consortium)
RPC	Remote Procedure Call
UI	User Interface
UID	User Interface Description
UIP	User Interface Plug-in
UUID	Universally unique identifier
XML	Extensible markup language
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e. V.

3.8 Conventions

Capitalization of the first letter of words beyond those defined in ISO/IEC Directives Part 2 is used in the IEC 62769 series to emphasize an FDI-specific meaning. It is used for the following cases:

- Defined terms
- Names of Services defined in IEC 62769-2
- Names of FDI Package elements defined in IEC 62769-4
- Names of Information Model elements defined in IEC 62769-5

EDD language elements are written with all letters in uppercase.

4 Background

4.1 Motivation

In today's automation systems, field devices from many different suppliers have to be integrated into the system, which results in additional effort for installation, version management and operation of these devices. This challenge is best met with an open and standardized device integration solution.

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[1] FDT logo is a trade name of the non-profit organization FDT Group AISBL. 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 trade names holder or any of its products. Compliance does not require use of the registered trade name. Use of the trade names requires permission of the trade name holder.

Two different device integration technologies exist: the Electronic Device Description Language (EDDL) in accordance with IEC 61804 and the Field Device Tool (FDT®) in accordance with IEC 62453. While these technologies take different approaches to solve the problem, there is a lot of overlap between them. This has led to a situation where the technologies compete instead of complementing each other. As a result, system suppliers have taken their positions, device suppliers have had to double their efforts in order to support EDDL and FDT®, and the end users have become frustrated because they want the best of both technologies.

For all parties involved, the ideal solution looks different. System suppliers want to achieve robustness while assuring a high level of technology and platform independence. Device suppliers want to support only one technology instead of two in order to reduce cost and effort, and they want to provide the optimal means for operating their devices. End users want to avoid false investments and therefore demand only one future-proof solution that offers all the advantages of the competing technologies.

4.2 Electronic Device Description Language (EDDL)

The Electronic Device Description Language (EDDL) is a language for describing the behavior of field devices. It enables systems to configure, calibrate, troubleshoot, and operate a field device without any prior knowledge of the device.

Device descriptions written in EDDL describe the capabilities of the field device; it is up to the system to determine how to utilize these capabilities. These device descriptions enable systems to access all the data and properties of all devices, which simplifies the maintenance, support, and operation of the devices. It works well for small handheld applications and large integrated automation systems. It works well for embedded systems and systems running on commercial operating systems.

With EDDL, the device supplier can organize the device's data, properties, and procedures for access by the end user. This provides the system guidance in dynamically creating a user interface for the device. The capabilities of this user interface can vary significantly for different classes of devices, and it can be as simple or complex as the device being described.

In the early 1990s, the first version of EDDL was created and was used to describe HART field devices. In 1996, the EDDL was used to describe FOUNDATION Fieldbus devices. Then in 2000, it was used to describe PROFIBUS devices. All three versions of EDDL can trace their lineage back to the original HART version. Therefore, all three versions are largely the same, with some differences due to differences in the underlying communication protocols. EDDL was standardized first as part of IEC 61804-3 and IEC 61804-4 in March 2004.

4.3 Field Device Tool (FDT®)

FDT® is an interface specification that standardizes the interface between the device software and the systems. It provides independence from the communication protocol and establishes a clear boundary between the software provided by the device supplier and the software provided by the system supplier.

In FDT®, field devices are delivered with a device-specific software component called a Device Type Manager (DTM), which is only functional when used in conjunction with an FDT®-specific environment called a "frame application". A frame application interacts with a DTM through a set of standard FDT® interfaces.

A device supplier can develop a DTM for each of its devices, or it can develop a DTM for a group of devices. A DTM can be used to access Device Parameters, configure and operate the device, and diagnose problems. A DTM can range from a simple Graphical User Interface (GUI) for setting Device Parameters to a highly sophisticated application for performing complex calculations for diagnosis.

DTMs can be nested in order to support Modular Devices. The nesting of DTMs also allows multi-level communication hierarchies to be supported. Devices routed through different bus protocols can be connected through standard interfaces. A device DTM just has to support its own communication protocol. Gateway DTMs that connect to the device DTM handle protocol transformation.

The FDT® specification supports a variety of bus protocols, for example: PROFIBUS, HART, FOUNDATION Fieldbus, Interbus, AS-interface, IO-Link, DeviceNet, and PROFINET IO.

In 1998, the specification phase started in the context of the Zentralverband Elektrotechnik und Elektronikindustrie e. V. (ZVEI). In 1999, completion of the technology was accelerated when the specification was adopted by PROFIBUS Nutzerorganisation e. V. (PNO), which later transferred the rights to the FDT Group AISBL. FDT® was standardardized as IEC 62453-1 in May 2009.

4.4 OPC Unified Architecture (OPC UA)

OPC Unified Architecture (OPC UA) is a platform-independent standard through which various kinds of systems and devices can communicate by sending messages between clients and servers over various types of networks. It supports robust, secure communication that assures the identity of clients and servers and resists attacks.

OPC UA defines standard sets of services that servers can provide, and individual servers specify to clients what service sets they support. The services act on an object model which is managed by the server and discoverable by a client. Information is conveyed using standard and vendor-defined data types, and servers define object models that clients can dynamically discover. Servers can provide access to both current and historical data, as well as alarms and events to notify clients of important changes.

OPC UA can be mapped onto a variety of communication protocols and data can be encoded in various ways to trade off portability and efficiency. Transports and encodings for XML based Web Services as well as a high-performance binary are defined for OPC UA. The abstraction of the OPC UA standard from any particular technology provides future-proofing allowing OPC UA to be mapped onto future technologies.

The integration of system components includes a "how" factor and a "what" factor. The comprehensive set of services provided by OPC UA enables the "how" of system integration. OPC UA also provides the basic building blocks of the "what" of system integration by defining an extensible object model. Other standards bodies, vendors, and end users can extend this object model to achieve a tight integration between system components.

OPC UA is standardized in IEC 62541.

5 Architecture

5.1 Overview

The FDI architecture consists of FDI Packages, FDI Clients, and FDI Servers as shown in Figure 1.

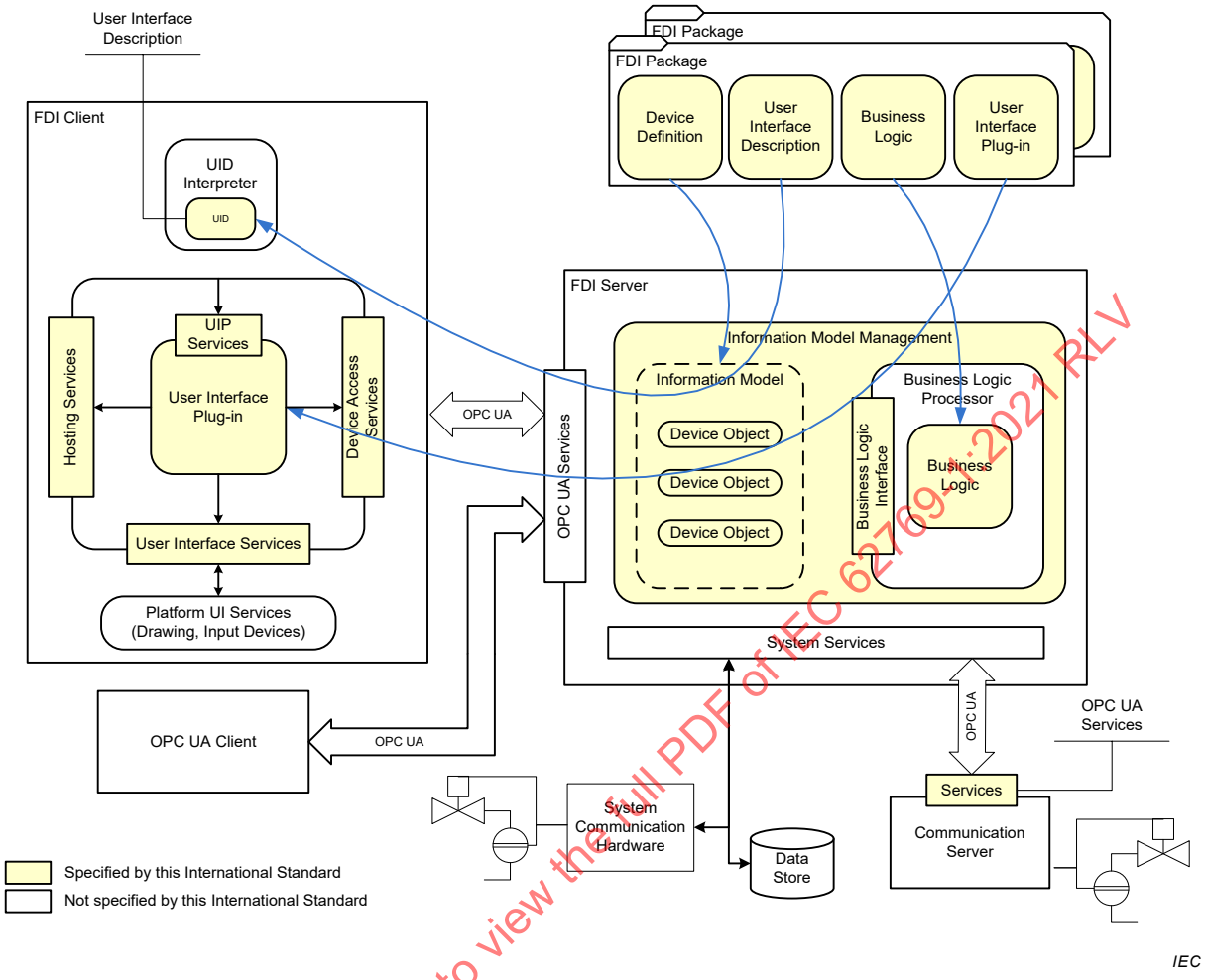


Figure 1 – FDI architecture diagram

5.2 FDI Packages

FDI Packages are the means by which device vendors provide information about their devices to system vendors. FDI Packages collect all of the device information required by a system vendor in one place. FDI Packages are system independent, i.e. device vendors provide the same FDI Package to all system vendors.

An FDI Package includes the following:

- Device Definition – Core definition of the device that is used by an FDI Server to create the Information Model.
- Business Logic – Ensures the integrity of the Information Model.
- User Interface Description – Declarative user interface that is rendered by an FDI Client via a UID Interpreter.
- User Interface Plug-in – Optional programmed user interface that is hosted by an FDI Client.

The Device Definition and Business Logic are used exclusively by an FDI Server. The User Interface Description is processed by the FDI Server and transferred to the FDI Client. User Interface Plug-ins are not processed by the FDI Server, beyond what is necessary to deliver them to the FDI Client.

The Device Definition, Business Logic, and User Interface Description are completely platform independent. User Interface Plug-ins shall be targeted at a specific run-time environment. Distinct User Interface Plug-ins can be developed for different run-time environments, but a specific User Interface Plug-in will only run on a single run-time environment.

The content of an FDI Package is specified in IEC 62769-4.

5.3 FDI Client

FDI Clients interpret and render descriptive user interface contents (UID, Device Parameter values and so on) that are delivered to an FDI Client via the Information Model of an FDI Server in a specified format and through defined services. Interpretation of the EDD portion of an FDI Package however is only done in the FDI Server. In addition, FDI Clients also host User Interface Plug-ins.

The environment for hosting User Interface Plug-ins consists of four sets of services: the Hosting Services, the UIP Services, the User Interface Services, and the Device Access Services.

- The Hosting Services provide the means by which a User Interface Plug-in interacts with the FDI Client.
- The UIP Services provide the means by which an FDI Client can activate, control, and shutdown the User Interface Plug-in.
- The User Interface Services provide the means by which a User Interface Plug-in accesses the operating system specific Platform UI Services, which provide access to the screen, keyboard, mouse, and so on.
- The Device Access Services provide the means by which a User Interface Plug-in accesses the Information Model in an FDI Server.

The behavior of an FDI Client is specified in IEC 62769-2.

5.4 FDI Server

FDI Servers provide FDI Clients access to information about Device Instances and Device Types regardless of where the information is stored, for example, in the device itself or in a data store. This information can be provided via OPC UA services.

The Information Model specifies the entities that can be accessed in an FDI Server, including their properties, their relationships, and the operations that can be performed on them. The Information Model is driven largely by the Device Definitions in FDI Packages. The Information Model is based on the Information Model specified in the OPC UA Devices Specification.

The FDI Server invokes the Business Logic in FDI Packages as entities in the Information Model are accessed. One of the main purposes of the Business Logic is to keep the Information Model consistent.

The Business Logic Interface is the means by which Business Logic is integrated with the Information Model. This interface consists of a set of well-defined Business Logic entry points, which can be used by the Information Model to invoke Business Logic, and a set of well-defined Information Model entry points, which can be used by the Business Logic to access the Information Model.

An FDI Server shall support all elements of an FDI Package.

Some of the information managed by an FDI Server shall be stored persistently. The means by which this data is stored is server-specific.

The behavior of an FDI Server is specified in IEC 62769-3, and the Information Model is specified in IEC 62769-5.

5.5 FDI Communication Server

An FDI Server inherently knows how to communicate with devices via the communication hardware it natively supports. In addition, an FDI Communication Server can be used to extend the devices that the FDI Server can communicate with. An FDI Server communicates with an FDI Communication Server via standard communication services that are specified in IEC 62769-7.

5.6 User Interface tiering

There are three tiers of user interfaces that can be developed using FDI.

The lowest tier is a User Interface Description based user interface. This kind of user interface is completely defined by a User Interface Description. It is the easiest user interface to create, but it also has the most limitations. This kind of user interface is sufficient for relatively simple devices.

The second tier is a User Interface Plug-in based user interface. This kind of user interface is defined via the combination of a User Interface Description and one or more User Interface Plug-ins. This is a more complicated user interface to build since it involves some software development, but it also can produce a more sophisticated user interface. This kind of user interface is required for some complex devices.

The third tier is an FDI Client. An FDI Client may access multiple devices, while User Interface Descriptions and User Interface Plug-ins may only access a single device. This kind of user interface is required when access to multiple devices is required.

5.7 FDI security considerations

FDI is used between components in the operation of an industrial facility at multiple levels: from high-level enterprise management applications accessing device data to low-level direct process control of a device. Such a system may be an attractive target for industrial espionage or sabotage, and may also be exposed to threats through untargeted malware such as worms circulating on public networks. Corrupted device configurations could result in financial losses, affect employee and public safety, or cause environmental damage.

FDI relies on many other systems within the industrial facility. The FDI Clients and Servers are installed on IT systems. Standard communication protocols such as OPC UA and field bus protocols are used for communication between the FDI Clients and the FDI Server as well as between the FDI Server and the devices. Therefore, FDI security should work within the overall Cyber Security Management System (CSMS) of a site. A CSMS typically addresses threats, analyses the security risks and determines what security controls the site needs.

Resulting security controls commonly implement a "defence-in-depth" strategy that provides multiple layers of protection and recognizes that no single layer can protect against all attacks. Boundary protections may include firewalls, intrusion detection and prevention systems, controls on dial-in connections, and controls on media and computers that are brought into the system. Protections in components of the system may include hardened configuration of the operating systems, security patch management, anti-virus programs, and not allowing email in the control network. Standards that may be followed by a site include the IEC 62443 series and IEC TR 62351-10.

The system owner that installs FDI Clients or Servers should analyse its security risks and provide appropriate mechanisms to mitigate those risks to achieve an acceptable level of security.

Developers of FDI Clients and Servers should analyse security threats to the system and implement appropriate countermeasures. The threats and appropriate countermeasures depend on the technologies used for implementation and fall outside the scope of the FDI specification.

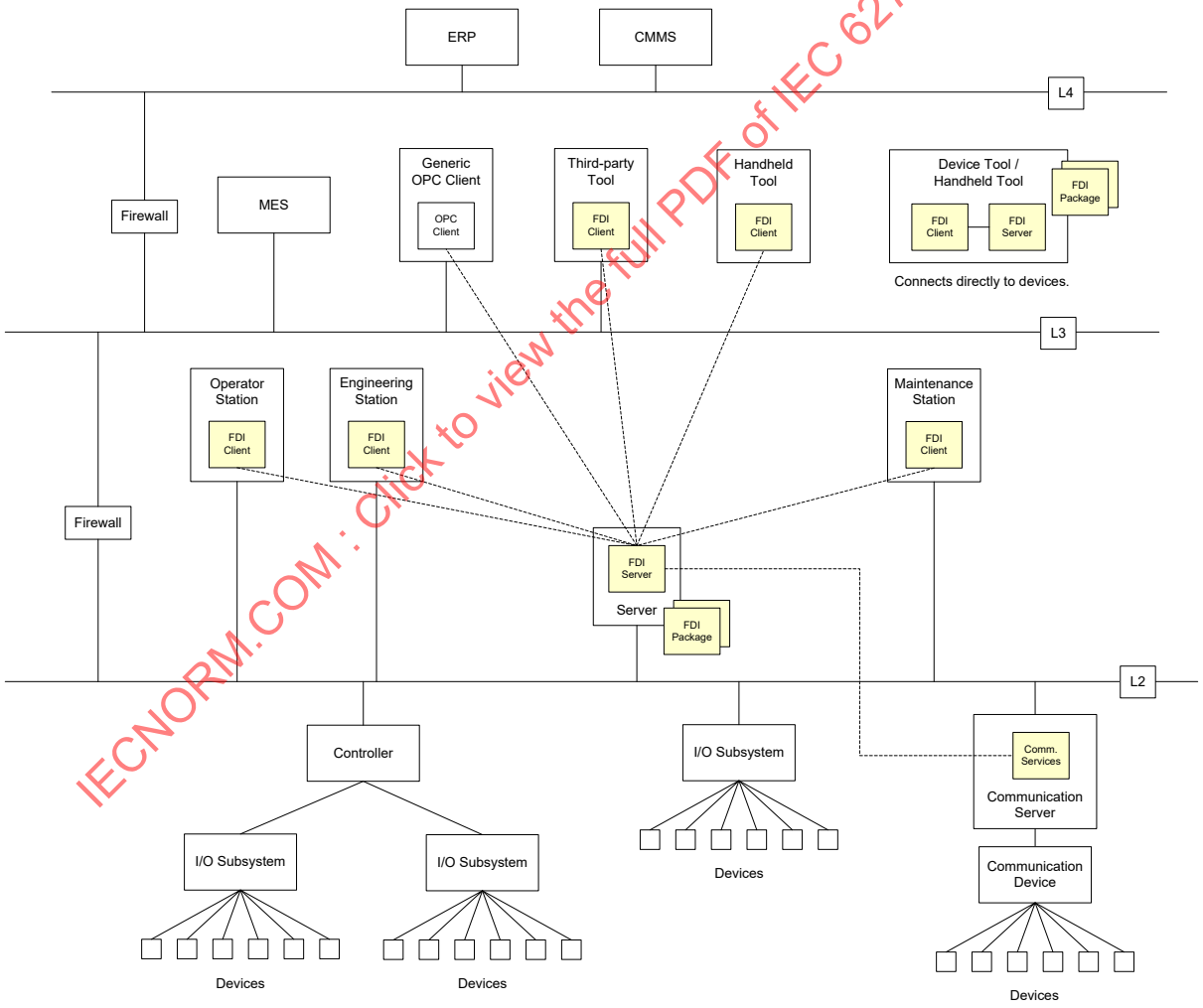
5.8 Redundancy

Redundancy is system specific and managed by the automation system. FDI Packages are specified without regard to redundancy. User Interface Descriptions and User Interface Plug-ins have no knowledge about the redundancy of the devices they are associated with.

6 Deployment

6.1 Overview

The FDI specification does not mandate a specific deployment strategy. However, a typical deployment scenario is shown in Figure 2. The shaded boxes correspond to the components described in 5.2, 5.3, 5.4, and 5.5.



IEC

Figure 2 – Typical deployment scenario

6.2 Engineering, operator and maintenance stations

The engineering, operator and maintenance stations are part of an automation system through which users engineer, operate and maintain their plant. One or more FDI Clients can be running on these stations. These FDI Clients are full-featured clients that can interpret User Interface Descriptions and execute User Interface Plug-ins.

6.3 FDI Server

An FDI Server is provided as part of the automation system. FDI Packages are installed on the FDI Server. The FDI Server serves up information from the FDI Packages to the FDI Clients.

The supplier of the automation system can provide both an FDI Server and one or more FDI Clients. These FDI Clients can communicate with the FDI Server through proprietary protocols; however, if the FDI Server supports third-party FDI Clients it shall support OPC UA.

The FDI Server is usually distinct from the servers that provide run-time data to the operator, engineering, and maintenance stations.

6.4 FDI Communication Servers

An FDI Communication Server can be embedded within a Communication Device or can be provided via a separate server as shown in Figure 2.

6.5 Device Tools

A Device Tool is a standalone application that contains both an FDI Client and an FDI Server. The FDI Packages supported by the Device Tool are installed along with the Device Tool.

6.6 Third-party Tools

Third-party Tools are applications that contain an FDI Client and communicate with the automation system's FDI Server. While these tools can be provided by the supplier of the automation system, they are often provided by other vendors.

6.7 Handheld Tools

Handheld Tools are applications running on handheld devices. Handheld Tools can be implemented as a Device Tool, where an FDI Client, an FDI Server, and FDI Packages are installed on the handheld device. Handheld Tools can also be implemented as a third-party tool where only an FDI Client is installed on the handheld device.

6.8 Generic OPC UA Clients

When an FDI Server is an OPC UA Server (see 6.3), generic OPC UA Clients with no knowledge of FDI can connect to the FDI Server. These clients are limited to general access of the Information Model. In particular, the lack of understanding of User Interface Descriptions and User Interface Plug-ins prevents them from rendering an FDI-based user interface.

7 FDI Host

7.1 Overview

FDI Hosts are combinations of FDI Client and FDI Server applications capable of consuming FDI Packages. FDI Hosts are used to access Device data (typically Field Device and Communication Device Parameters) through User Interfaces or directly and may allow the modification of the Device data. FDI Hosts are subjected to FDI Host Conformance Tests.

There are several possibilities of how FDI Hosts may be structured. Subclauses 7.2 and 7.3 list the different FDI Host Variants, Entities and so-called Facets.

7.2 FDI Host Variants and Entities

There are different ways to implement and structure an FDI Host:

- FDI Host (Single User)
  Deployed to a single device (e.g. notebooks, mobile computer). Only a single user can work with the host at a time. Typical examples are so called Device Tools, standalone device management applications and handheld devices.
- FDI Host (Multi User)
  Installed on a single device but potentially also on several devices (e.g. Client/Server architecture). Multiple users are allowed to use the FDI Host at a time. Concurrent access to device data and the concurrent use of User Interfaces is normal to those hosts. Typical examples are distributed host systems and asset management systems.
- FDI Client (OPC UA)
  An FDI aware client application usually provided separately from a DCS (Distributed Control System) and typically provided from a different vendor. This FDI Client application requires an FDI Host supporting the FDI Information Model Facet (see 7.3) and is only possible with FDI Host (Multi User) variant.
- FDI Communication Server
  This server application is used to connect communication hardware to a communication network (as so called network entry point). The FDI Communication Servers are integrated via FDI Communication Packages but the software as such comes separately or is implemented embedded into the communication hardware. The FDI Communication Server requires an FDI Host supporting the FDI Communication Server Facet.

7.3 FDI Host Facets

Optional aspects can be added to FDI Host implementations, extending the host with additional capabilities (see Table 1 and Table 2).

- FDI Information Model Facet
  An FDI Host implementing this facet is required to provide an FDI Information Model as per IEC 62769-5 and to support OPC UA as a communication mechanism between FDI Servers and Client applications. The host therefore allows using FDI Client (OPC UA) applications.
- FDI Communication Server Facet
  The capabilities of this facet allow the FDI Host to use FDI Communication Servers. Those grant access to communication networks, via Communication Devices that can now be integrated into an FDI Host via FDI Communication Packages as per IEC 62769-7 and IEC 62769-4.

Table 1 – FDI Host Variants and possible Facets

FDI Host Variants		Information Model Facet	Communication Server Facet
FDI Host	Single User	—	X
	Multi User	X	X

Table 2 – FDI Host Facets and related FDI Entities

FDI Entities		Information Model Facet	Communication Server Facet
FDI Client (OPC UA)	—	X	—
FDI Communication Server	—	—	X

8 Life-cycle model

8.1 Overview

The FDI life-cycle model defines how different versions of FDI Clients, FDI Servers, FDI Packages, and devices can co-exist within a given system over time. The model is focused on the ability to add FDI Packages to a system without having to update FDI Clients or FDI Servers. The model supports the life-cycle model of devices, which includes adding, upgrading, and replacing devices in a system.

The life-cycle model is based on the following principles.

- Every FDI Client, FDI Server, and FDI Package shall have an FDI version number. This version number shall be the version of the FDI specification to which the client, server, or package was built. The major revision of all clients, servers, and packages in a given system shall be the same.
- If any specification referenced by the FDI specification changes, the revision of the FDI specification shall change.
- The version of the underlying technology shall be independent of the FDI version.
- The FDI version supported by a specific FDI Client, FDI Server, or FDI Package can be queried.
- The version of the underlying technology supported by a specific FDI Client, FDI Server, or FDI Package can be queried. Version queries can be used to determine interoperability and compatibility between FDI Clients, FDI Servers, and FDI Packages.
- The algorithm for associating an FDI Package with a physical device is protocol-specific.

A summary of the FDI life-cycle concept is given in Annex A.

8.2 Identification mechanism

Universally unique identifiers (UUID) shall be used to uniquely identify entities within the FDI, see ISO/IEC 11578.

A UUID is a 16-byte number that is usually expressed as a sequence of 32 hexadecimal digits, displayed in 5 groups separated by hyphens, in the following form:

xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx

The following regular expression more precisely specifies the format of a UUID:

```
^(\{{0,1}[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-
F]{12}\}{0,1})$
```

8.3 Versioning mechanism

8.3.1 Version levels

8.3.1.1 Overview

The following pattern shall be used for all version numbers:

<major release>.<minor release>.<revision>-<build number>

Subclauses 8.3.1.2 to 8.3.1.5 specify the standard behavior when dealing with different versions. Some installations, for example in regulated industries, may require different handling.

8.3.1.2 Major release

Significant changes have been made that are not compatible with previous major releases. The necessity for those changes can be technology motivated, for example, an incompatible change of interfaces. They can also be strategically motivated, for example, the introduction of a new generation of existing elements.

A major release coexists with other major releases of the same entity. The increment of a major release requires the UUID of the affected entity to be changed.

8.3.1.3 Minor release (element upgrade)

A fully backward compatible functional extension has been made, for example, by adding features or functionality. No actions have to be taken to use the updated entity in the existing environment. The entity fully interoperates with already deployed entities that might have lower minor release numbers.

A minor release overwrites an already deployed previous version of the same entity. The increment of a minor version number shall not impact the UUID of the affected entity.

8.3.1.4 Revision (element update)

A fully backward compatible correction or editorial change has been made, i.e. a change that does not include any functional extensions. No actions have to be taken to use the updated entity in the existing environment. The entity fully interoperates with already deployed entities that might have lower revision numbers.

A revision overwrites an already deployed previous version of the same entity. The increment of a revision number shall not impact the UUID of the affected entity.

8.3.1.5 Build number

The build number shall not be exposed to the end user and shall only be used for internal development purposes.

8.3.2 FDI Technology Version

8.3.2.1 General

The FDI technology as such has to be versioned to make sure that all individually developed and provided elements are able to interoperate. The above described versioning mechanisms and principles shall be applied to the FDI Technology Version.

The FDI Technology Version is directly and indirectly influenced by several factors such as interface changes/adjustments, behavior changes/adjustments, and changes of underlying technologies (referenced specifications).

FDI components shall check the FDI Technology Version of connected components or FDI Packages to be consumed to ensure that both have the necessary FDI specific capabilities and are therefore able to interoperate.

An FDI Server, for example, is implemented following a specific FDI Technology Version and therefore supports all FDI Packages following the same version or lower. FDI Clients can typically be connected to FDI Servers that are implemented following the same FDI Technology Version or higher.

The following indicate the FDI Technology Version they support:

- FDI Client (see IEC 62769-2);
- FDI Server (see IEC 62769-3);
- FDI Package (see IEC 62769-4);
- User Interface Plug-in (see IEC 62769-4).

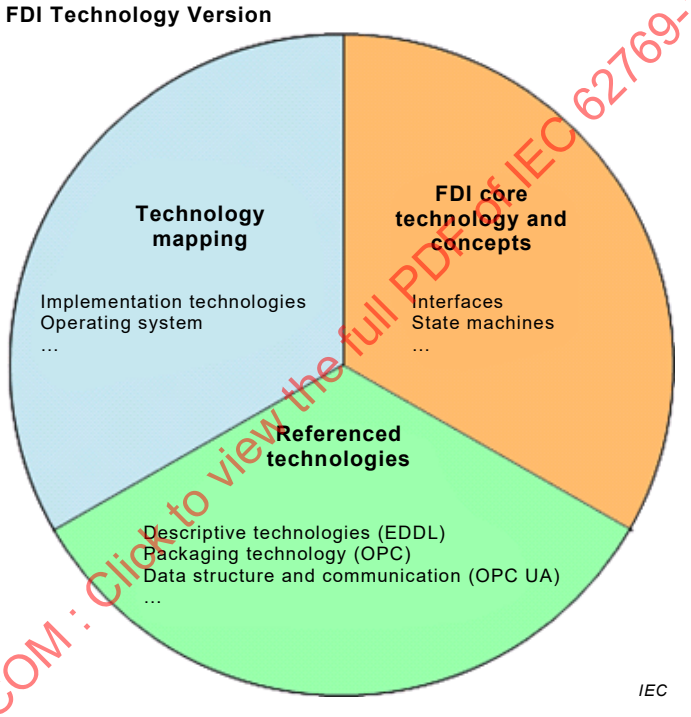


Figure 3 – FDI Technology Version dependencies

Figure 3 shows the influencing factors on the FDI Technology Version which are further described in 8.3.2.2 to 8.3.2.4.

8.3.2.2 FDI core technology and concepts

The FDI core technology and concepts are defined in all referenced parts of this specification. The specified interfaces, behaviors, state machines, and concepts have to be implemented in accordance with this specification to ensure interoperability of FDI components.

Changes to the specification documents, such as fixing typographical errors, rephrasing to increase the clarity of the document, and other similar changes shall lead to an increment of the revision of the FDI Technology Version.

Changes to the FDI core technology and concepts to improve the technology or to extend the feature set that are fully backward compatible shall lead to an increment of the minor release of the FDI Technology Version.

If non-backward compatible changes are necessary, a new generation of the FDI technology shall be created by incrementing the major release of the FDI Technology Version.

Issue reporting processes concerning FDI core technologies are described in Annex B.

8.3.2.3 Technology mapping

FDI components can be implemented using different implementation technologies and can also run on multiple platforms and operating systems. The details of those technologies are specified in IEC 62769-6.

Updates to mapped technologies shall not lead to an increment of the revision of the FDI Technology Version.

The minor release of the FDI Technology Version shall be incremented when mapped technologies are upgraded without disturbing the interoperability and the proper execution of FDI components, for example, fully backward compatible operating system changes or introduction of additional implementation technologies, platforms, or operating system versions supported.

Incompatible changes or the discontinuing of mapped technologies shall lead to a new generation of FDI and an increment to the major release of the FDI Technology Version.

8.3.2.4 Referenced technologies

The FDI technology references technologies which are used to make possible and support specified functions and concepts of FDI. Those referenced technologies are maintained outside the scope of FDI.

IEC 62769-6 lists the versions of the specifications referenced. Implementation of FDI components using different versions is not permitted.

Updates to referenced technologies shall not lead to an increment of the revision of the FDI Technology Version.

If a referenced technology specification is changed, the new version of the specification shall be adopted into FDI if those changes are fully backward compatible and those improvements also increase the value of FDI. The decision to adopt a new specification version of a referenced technology shall lead to an increment of the minor release of the FDI Technology Version.

Generation changes of referenced technologies shall only be adopted by the FDI if this generation is fully compatible with the previous generation. These changes shall lead to an increment of the minor release of the FDI Technology Version but not to the major release.

Table 3 summarizes influences on the FDI Technology Version.

Table 3 – Summary of influences on the FDI Technology Version

Influence	FDI Technology Version – Version level		
	Revision	Minor	Major
FDI core technology and concepts	Editorial	Extend interfaces Extend functionalities	Generation change by introducing non backward compatible functions or by removing existing aspects
Technology mapping	n/a	Upgrade, fully compatible extensions or generations of mapped technologies	Incompatible changes or discontinuing of mapped technologies
Referenced technologies	n/a	Change if new reference technology fully backward compatible and increasing value	n/a

At least two succeeding major FDI Technology Versions (the latest and the previous generation of FDI) shall be supported in parallel as part of a single FDI Host installation. Support means that FDI Server(s) and FDI Client(s) implement the specifics of the supported technology versions and also accept the import of FDI Packages based on those FDI Technology Versions.

8.3.3 Forward compatibility

8.3.3.1 Version combinations to be handled

FDI Packages are designed to a specific FDI Technology Version that is reflected in the FdiVersionSupported property of the respective FDI Package (see IEC 62769-6). FDI Servers and FDI Clients are also designed to a specific FDI Technology Version.

Table 4 specifies the combinations of FDI Package and FDI Client/Server that shall be supported. Subclauses 8.3.3.2 to 8.3.3.6 describe how each use case shall be handled.

Table 4 – Combinations of Minor Versions that require special handling

Component	FDI Technology Version – Minor version		
	< FDI Package	= FDI Package	> FDI Package
FDI Server	Deployment IM Creation Business Logic Execution User Interface Description	No special handling needed	Rules of backward compatibility, no special handling needed
FDI Client	Visualization (UID) UIP Execution	No special handling needed	Rules of backward compatibility, no special handling needed

8.3.3.2 Deployment

FDI Packages can be deployed to FDI Servers even if the FDI Package's FDI Technology Version is higher than the FDI Server's FDI Technology Version. An automatic blocking mechanism for such FDI Packages is prohibited. During the deployment process the user shall be clearly informed when an FDI Package with a higher version than is supported by the FDI Server is being deployed.

8.3.3.3 Information Model creation

The Information Model nodes are created on the basis of the EDD provided by the FDI Package. If there are EDD constructs that are not known to the FDI Server, the creation of the Information Model shall be cancelled since it cannot be ensured that the FDI Package can be properly imported and that a consistent Information Model can be created. The FDI Server shall provide mechanisms to inform the user about the incompatibility.

8.3.3.4 Business Logic execution

Business Logic is executed by the FDI Server to create nodes in the Information Model and to protect the integrity of the Information Model. If there are EDD constructs (including built-in functions) that are not known to the FDI Server, the execution of the Business Logic shall be cancelled since it cannot be ensured the Business Logic will not endanger the integrity of the Information Model. The FDI Server shall provide mechanisms to inform the user about the incompatibility.

8.3.3.5 User Interface Description/Visualization

User Interface Descriptions are created from EDD information and sent to the FDI Client by the FDI Server. If the FDI Client's UID Interpreter is not able to interpret and/or visualize a part of the UID the user shall be informed, for example, by showing an empty control with an embedded question mark.

8.3.3.6 UIP execution

The forward compatibility of User Interface Plug-ins depends on the forward compatibility capabilities of the underlying implementation technology, see IEC 62769-6.

Annex A
(informative)

FDI life-cycle concept summary

A.1 General

All aspects of the FDI technology supporting a stable and secure life cycle of FDI-based products are essential part of the technology itself. Therefore, the different parts that can be called an FDI life-cycle concept are spread around the different specification parts. Annex A summarizes the most relevant aspects as a reference.

A.2 Life-cycle relevant topics (references)

Table A.1 and Table A.2 provide the life-cycle aspects.

Table A.1 – Life-cycle aspects as part of the FDI technology

Aspect	FDI specification document	Reference
FDI Package Version and dependencies	IEC 62769-4:2020 (FDI Packages)	Clause 6
FDI Packages scale with the described devices	IEC 62769-4:2020 (FDI Packages)	Clause 4
FDI Technology Version	IEC 62769-1:2020 (Overview)	Clause 8
Open and defined Information Model	IEC 62769-5:2020 (FDI Information Model)	Clause 7
Referenced technologies	IEC 62769-6:2020 (FDI Technology Mapping)	Table 1
Supported Firmware revisions of the FDI Package	IEC 62769-4:2020 (FDI Packages)	Annex E
Supported UIP revisions of the FDI Package	IEC 62769-4:2020 (FDI Packages)	Annex E
Technologies directly used by FDI	IEC 62769-6:2020 (FDI Technology Mapping)	Clause 4
Versioning concept for FDI components	IEC 62769-1:2020 (Overview)	Clause 8
FDI Package Registration Certification and signing mechanisms	IEC 62769-4:2020 (FDI Packages)	Clause 7
Typical Use Cases during the life cycle	IEC 62769-4:2020 (FDI Packages)	Annex G

Table A.2 – Life-cycle aspects as part of products and services provided with the FDI technology

Aspect	Product & Service
FDI Package Conformance Testing	FDI Conformance testing services provided by protocol foundations
FDI Host Conformance Testing	FDI Conformance testing services provided by protocol foundations
FDI common EDD binary format	EDDL Encoded File Format specification implemented in FDI Common Host Components
FDI Standard Host components	FDI Common Host Components provided by the protocol foundations
Single registered FDI Package per firmware revision supported	Ensured via FDI Conformance testing services provided by the protocol foundations
FDT® Interoperability	FDI.dll provided by the protocol foundations
Harmonized EDDL	

Annex B
(informative)

Issue reporting

FieldcommGroup strives to maintain the highest quality standards for its published specifications; hence they undergo constant review and refinement. Readers are encouraged to report any issues here:

http://go.fieldcommgroup.org/support

Bibliography

IEC 61804-3, *Function Blocks (FB) for process control and Electronic Device Description Language (EDDL) – Part 3: EDDL syntax and semantics*

IEC 61804-4, *Function blocks (FB) for process control and electronic device description language (EDDL) – Part 4: EDD interpretation*

IEC 61804-5, *Function blocks (FB) for process control and electronic device description language (EDDL) – Part 5: EDDL Builtin library*

IEC TR 62351-10, *Power systems management and associated information exchange – Data and communications security – Part 10: Security architecture guidelines*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

IEC 62453 (all parts), *Field device tool (FDT®) interface specification*

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

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

IEC 62769-3, *Field Device Integration (FDI) – Part 3: FDI Server*

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

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

IEC 62769-6, *Field Device Integration (FDI) – Part 6: FDI Technology Mapping*

IEC 62769-7, *Field Device Integration (FDI) – Part 7: Communication Devices*

ISO/IEC 11578, *Information technology – Open Systems Interconnection – Remote Procedure Call (RPC)*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI) –

Partie 1: Vue d'ensemble

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La Norme internationale IEC 62769-1 a été établie par le sous-comité 65E: Les dispositifs et leur intégration dans les systèmes de l'entreprise, du comité d'études 65 de l'IEC: Mesure, commande et automation dans les processus industriels.

Cette deuxième édition annule et remplace la première édition parue en 2015. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) prise en charge de l'extension de protocoles génériques qui vise à accélérer l'adoption d'autres technologies;

b) la signature numérique comprend désormais un horodatage de confiance pour la validation sur le long terme du paquetage FDI;

c) prise en charge de nouveaux protocoles.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
65E/758/FDIS	65E/768/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62769, publiées sous le titre général *Intégration des appareils de terrain (FDI)*, peut être consultée sur le site web de l'IEC.

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INTRODUCTION

La série IEC 62769 est publiée sous le titre général "*Intégration des appareils de terrain* (*FDI*)" et comporte les parties suivantes:

– Partie 1: Vue d'ensemble
– Partie 2: Client FDI
– Partie 3: Serveur FDI
– Partie 4: Paquetages FDI
– Partie 5: Modèle d'Information FDI
– Partie 6: Mapping de technologies FDI
– Partie 7: Appareils de Communication FDI
– Partie 100: Profils – Extensions de protocoles génériques
– Partie 101-1: Profils – Foundation Fieldbus H1
– Partie 101-2: Profils – Foundation Fieldbus HSE
– Partie 103-1: Profils – PROFIBUS
– Partie 103-4: Profils – PROFINET
– Partie 109-1: Profils – HART et WirelessHART
– Partie 115-2: Profils – Définitions spécifiques au protocole pour Modbus-RTU
– Partie 150-1: Profils – ISA 100.11a

INTÉGRATION DES APPAREILS DE TERRAIN (FDI) –

Partie 1: Vue d'ensemble

1 Domaine d'application

La présente partie de l'IEC 62769 décrit les concepts et donne une vue d'ensemble des spécifications d'intégration des appareils de terrain (FDI). La motivation détaillée pour la création de cette technologie est également décrite (voir 4.1). La lecture du présent document est utile pour comprendre les autres parties de cette norme en plusieurs parties.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC TR 62541-1, *OPC Unified Architecture – Part 1: Overview and Concepts* (disponible en anglais seulement)

IEC 62541-3, *Architecture unifiée OPC – Partie 3: Modèle d'espace d'adressage*

IEC 62541-4, *Architecture unifiée OPC – Partie 4: Services*

IEC 62541-5, *Architecture unifiée OPC – Partie 5: Modèle d'Informations*

IEC 62541-100, *Architecture unifiée OPC – Partie 100: Interface d'appareils*

3 Termes, définitions, termes abrégés et conventions

3.1 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC TR 62541-1, l'IEC 62541-3, l'IEC 62541-4, l'IEC 62541-5, l'IEC 62541-100, ainsi que les suivants, s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1.1
intégration des appareils de terrain
FDI
technologie d'intégration d'appareils et de gestion d'appareils, qui combine les concepts et les aspects technologiques fondamentaux du langage de description d'appareil électronique (EDDL – *Electronic Device Description Language*) conformément à l'IEC 61804 et de l'outil des appareils de terrain (FDT® - *Field Device Tool*) conformément à l'IEC 62453, ainsi que dans l'IEC 62541-1 (OPC UA – *Open Packaging Conventions Unified Architecture*)

Note 1 à l'article: La combinaison de ces différentes technologies éprouvées assure un cycle de vie sécurisé et la capacité de répondre à tous les défis relatifs à l'intégration d'appareils et à la gestion d'appareils d'une manière évolutive.

Note 2 à l'article: L'abréviation "FDI" est dérivée du terme anglais développé correspondant "*Field Device Integration*".

3.1.2
action
procédure qui exige une collaboration entre un client FDI et un serveur FDI

3.1.3
logique applicative
élément descriptif d'un paquetage FDI qui spécifie la logique de comportement et/ou de mapping, spécifique à un appareil pour une Communication Imbriquée

3.1.4
interface de logique applicative
interface à travers laquelle la Logique Applicative est intégrée au Modèle d'Information

3.1.5
appareil de communication
appareil physique qui donne l'accès aux réseaux et aux appareils

Note 1 à l'article: Les passerelles et les routeurs sont des exemples d'appareils de communication.

3.1.6
point de connexion
représentation logique d'une connexion entre un point d'extrémité de communication et un réseau de communication

3.1.7
services d'accès à l'appareil
ensemble de services à travers lesquels un Plugiciel d'Interface Utilisateur accède au Modèle d'Information d'un serveur FDI

3.1.8
définition d'appareil
élément exigé d'un Paquetage FDI qui fournit la définition de base d'un appareil

3.1.9
instance d'appareil
représentation d'un appareil spécifique dans le Modèle d'Information d'un Serveur FDI

3.1.10
outil d'appareil
application autonome qui contient un Client FDI et un Serveur FDI

3.1.11
topologie d'appareils
agencement de réseaux de communication et d'appareils qui forme un réseau

3.1.12
type d'appareil
représentation d'un type d'appareil dans le Modèle d'Information d'un Serveur FDI

3.1.13
client FDI
composant logiciel qui utilise le Modèle d'Information, interprète les descriptions d'interface utilisateur et héberge les plugiciels d'interface utilisateur

3.1.14
serveur de communication FDI
serveur OPC UA utilisé par un serveur FDI pour accéder aux réseaux non natifs

3.1.15
paquetage FDI
ensemble de composants qui fournit toutes les informations nécessaires à l'intégration d'un type d'appareil dans un système

3.1.16
serveur FDI
composant logiciel qui met en œuvre le Modèle d'Information, exécute la Logique Applicative et communique avec l'appareil par l'intermédiaire d'une Communication Native et/ou une Communication Imbriquée

3.1.17
version de technologie FDI
numéro de version qui s'identifie à une révision spécifique de l'ensemble de la technologie FDI

3.1.18
services d'hébergement
ensemble de services à travers lesquels un Plugiciel d'Interface Utilisateur interagit avec un Client FDI

3.1.19
modèle d'information
ensemble d'objets, de variables et de méthodes exposé par un Serveur FDI

3.1.20
appareil modulaire
appareil qui se compose d'un ou plusieurs sous-appareils

3.1.21
communication native
communication avec des appareils qui font partie intégrante du système

3.1.22
communication imbriquée
communication avec des appareils à travers une série d'appareils de communication

3.1.23
donnée hors ligne
information d'un appareil maintenue par un serveur FDI qui est stockée dans une base de données spécifique à un Serveur FDI

3.1.24
donnée en ligne
information d'un appareil maintenue par un Serveur FDI qui est récupérée à partir d'un appareil physique

3.1.25
services d'interface utilisateur
services d'UI
ensemble de services à travers lesquels un Plugiciel d'Interface Utilisateur accède au système d'exploitation

Note 1 à l'article: L'abréviation "UI" est dérivée du terme anglais développé correspondant "*User Interface*".

3.1.26
services d'interface utilisateur de la plate-forme
services d'UI de la plate-forme
services d'interface utilisateur fournis nativement par le système d'exploitation

3.1.27
description d'interface utilisateur
UID
élément descriptif d'un paquetage FDI qui est utilisé par un Client FDI pour restituer l'interface utilisateur

Note 1 à l'article: L'abréviation "UID" est dérivée du terme anglais développé correspondant "*User interface Description*".

3.1.28
interpréteur de description d'interface utilisateur
interpréteur d'UID
composant logiciel dans un Client FDI qui restitue les descriptions d'interface utilisateur et invoque des actions

3.1.29
plugiciel d'interface utilisateur
UIP
élément exécutable d'un paquetage FDI qui est exécuté par un Client FDI

Note 1 à l'article: L'abréviation "UIP" est dérivée du terme anglais développé correspondant "*User Interface Plug-in*".

3.1.30
services de plugiciel d'interface utilisateur
services d'UIP
ensemble de services à travers lesquels un Client FDI interagit avec un plugiciel d'interface utilisateur

3.2 Termes de l'IEC TR 62541-1 (OPC UA)

Pour les besoins du présent document, les termes et définitions suivants, tirés de l'IEC TR 62541-1, s'appliquent.

AddressSpace (Espace d'adressage)

Attribute (Attribut)

Client

Method (Méthode)

Node (Nœud)

NodeClass (Classe de nœud)

Notification

Object (Objet)

ObjectType (Type d'objet)

Reference (Référence)

ReferenceType (Type de référence)

Server (Serveur)

Service Set (Ensemble de services)

Session

Subscription (Abonnement)

Variable

3.3 Termes de l'IEC 62541-3 (OPC UA)

Pour les besoins du présent document, les termes et définitions suivants, tirés de l'IEC 62541-3, s'appliquent.

Aggregates (Agrégats)

ArrayDimensions (Dimensions de matrice)

AuditEvent (Événement d'audit)

AuditUpdateMethodEvent (Événement de méthode de mise à jour d'audit)

BrowseName (Nom d'exploration)

ByteString (Chaîne d'octets)

DataType (Type de données)

DataVariable (Variable de données)

Folder (Dossier)

HasComponent (Possède le composant)

HasProperty (Possède la propriété)

HasSubType (Possède le sous-type)

HasTypeDefinition (Possède la définition de type)

ModellingRule (Règle de modélisation)

NodeId (ID nœud)

Property (Propriété)

UserAccessLevel (Niveau d'accès utilisateur)

UserExecutable (Exécutable utilisateur)

Value (Valeur)

ValueRank (Rang de valeur)

3.4 Termes de l'IEC 62541-4 (OPC UA)

Pour les besoins du présent document, les termes et définitions suivants, tirés de l'IEC 62541-4, s'appliquent.

AddReferences (Ajout de références)

Browse (Explorer)

BrowseNext (Explorer le suivant)

Call (Appel)

CreateSession (Créer une session)

NodeManagement (Gestion de nœud)

Read (Lecture)

Request Header (En-tête de demande)

Response Header (En-tête de réponse)

StatusCode (Code de statut)

TranslateBrowsePathsToNodeIds (Convertir les chemins d'exploration en ID nœud)

UserIdentityToken (Jeton identité utilisateur)

Write (Écriture)

3.5 Termes de l'IEC 62541-5 (OPC UA)

Pour les besoins du présent document, les termes et définitions suivants, tirés de l'IEC 62541-5, s'appliquent.

BaseObjectType (Type d'objet de base)

PropertyType (Type de propriété)

3.6 Termes de l'IEC 62541-100 (OPC UA pour Appareils)

Pour les besoins du présent document, les termes et définitions suivants, tirés de l'IEC 62541-100, s'appliquent.

Block (Bloc)

Device (Appareil)

DeviceType (Type d'appareil)

Parameter (Paramètre)

3.7 Termes abrégés

DTM	Device Type Manager (gestionnaire de type d'appareil)
EDD	Electronic Device Description (description d'appareil électronique)
EDDL	Electronic Device Description Language (langage de description d'appareil électronique)
FB	Function Blocks (blocs fonctionnels)
FDI	Field Device Integration (intégration des appareils de terrain)
FDT®[1]	Field Device Tool (outil d'appareil de terrain, voir l'IEC 62453)
GUI	Graphical User Interface (interface utilisateur graphique)
n/a	Non applicable
OPC	Open Packaging Conventions (conventions paquetages ouverts)
OPC UA	OPC Unified Architecture (architecture unifiée OPC, voir l'IEC 62541)
PC	Personal Computer (ordinateur personnel)
PNO	PROFIBUS Nutzerorganisation e. V. (est une organisation régionale du consortium international PROFIBUS et PROFINET)
RPC	Remote Procedure Call (appel de procédure distante)
UI	User Interface (interface utilisateur)
UID	User Interface Description (description d'interface utilisateur)
UIP	User Interface Plug-in (plugiciel d'interface utilisateur)
UUID	Universally Unique IDentifier (identificateur unique universel)
XML	Extensible Markup Language (langage de balisage extensible)
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e. V.

[1] Le logo FDT est une appellation commerciale de l'organisation à but non lucratif FDT Group AISBL. Cette information est donnée à l'intention des utilisateurs de la présente partie de l'IEC 62769 et ne signifie nullement que l'IEC approuve ou recommande le détenteur des appellations commerciales ou l'emploi exclusif de ses produits. La conformité n'exige pas l'utilisation de l'appellation commerciale enregistrée. L'utilisation des appellations commerciales exige l'autorisation du détenteur des appellations commerciales respectives.

3.8 Conventions

La mise en majuscules de la première lettre des mots au-delà de ceux définis dans les Directives ISO/IEC, Partie 2 est utilisée dans la série IEC 62769 afin d'insister sur une signification spécifique FDI. Elle est utilisée dans les cas suivants:

- Termes définis
- Noms des Services définis dans l'IEC 62769-2
- Noms des éléments de Paquetage FDI définis dans l'IEC 62769-4
- Noms des éléments de Modèle d'Information définis dans l'IEC 62769-5

Les éléments de langage EDD sont écrits en majuscules.

4 Contexte

4.1 Motivation

Dans les systèmes d'automatisation actuels, les appareils de terrain proposés par nombre de fournisseurs différents doivent être intégrés dans le système, ce qui implique un effort supplémentaire pour l'installation, la gestion des versions et l'exploitation de ces appareils. La résolution de ce problème est facilitée en appliquant une solution ouverte et normalisée d'intégration des appareils.

Deux technologies différentes d'intégration d'appareils existent: le langage de description d'appareil électronique (EDDL) conformément à l'IEC 61804 et l'outil des appareils de terrain (FDT®) conformément à l'IEC 62453. Bien que ces technologies adoptent des approches différentes pour résoudre le problème, elles se recoupent largement, ce qui a provoqué une situation de concurrence entre elles et non une situation de complémentarité réciproque. En conséquence, les fournisseurs de systèmes ont pris position, les fournisseurs d'appareils ont dû redoubler leurs efforts afin de prendre en charge les technologies EDDL et FDT®, et les utilisateurs finaux se sont sentis lésés, car ils souhaitaient bénéficier du meilleur des deux technologies.

Pour toutes les parties concernées, la solution idéale semble différente. Les fournisseurs de systèmes souhaitent parvenir à une certaine robustesse tout en assurant un haut niveau de technologie ainsi que l'indépendance entre plates-formes. Les fournisseurs d'appareils souhaitent prendre en charge une seule technologie au lieu de deux, afin de réduire le coût et l'effort engagés. Ils souhaitent par ailleurs proposer les moyens optimaux pour exploiter leurs appareils. Les utilisateurs finaux souhaitent éviter les faux investissements et n'exigent par conséquent qu'une seule solution pérenne qui offre tous les avantages des technologies concurrentes.

4.2 Langage de description d'appareil électronique (EDDL)

Le langage de description d'appareil électronique (EDDL) est un langage destiné à décrire le comportement d'appareils de terrain. Il permet aux systèmes de configurer, d'étalonner, de dépanner et d'exploiter un appareil de terrain sans aucune connaissance préalable de l'appareil.

Les descriptions d'appareils rédigées en langage EDDL décrivent les capacités de l'appareil de terrain; il incombe au système de déterminer comment utiliser ces capacités. Ces descriptions d'appareils permettent aux systèmes d'accéder à toutes les données et les propriétés de tous les appareils, ce qui simplifie la maintenance, la prise en charge et l'exploitation des appareils. Cette méthode s'applique parfaitement aux petites applications nomades et aux larges systèmes d'automatisation intégrés, ainsi qu'aux systèmes embarqués et aux systèmes fonctionnant sur les systèmes d'exploitation commerciaux.

Avec EDDL, le fournisseur d'appareils peut organiser les données, les propriétés et les procédures des appareils pour l'accès par l'utilisateur final. Des recommandations relatives au système sont ainsi fournies par la création dynamique d'une interface utilisateur pour l'appareil. Les fonctionnalités de cette interface utilisateur peuvent varier considérablement d'une classe d'appareils à une autre, et elle peut être aussi simple ou aussi complexe selon la description de l'appareil.

Au début des années 1990, la première version du langage EDDL a été créée et a été utilisée pour décrire les appareils de terrain HART. En 1996, le langage EDDL a été utilisé pour décrire les appareils FOUNDATION Fieldbus. Puis en 2000, il a été utilisé pour décrire les appareils PROFIBUS. Les trois versions du langage EDDL peuvent toutes retracer leur lignée à la version HART originale. Par conséquent, ces trois versions sont en grande partie les mêmes, avec quelques différences dues à des différences dans les protocoles de communication sous-jacents. EDDL a été normalisé tout d'abord comme une partie de l'IEC 61804-3 et de l'IEC 61804-4 en mars 2004.

4.3 Outil des appareils de terrain (FDT®)

FDT® est une spécification d'interface qui normalise l'interface entre le logiciel de l'appareil et les systèmes. Cet outil offre une indépendance par rapport au protocole de communication et établit une ligne de démarcation claire entre le logiciel proposé par le fournisseur d'appareils et le logiciel proposé par le fournisseur du système.

Avec la technologie FDT®, les appareils de terrain sont livrés avec un composant logiciel spécifique à l'appareil appelé "Gestionnaire de type d'appareil (DTM)", qui ne fonctionne que lorsqu'il est utilisé avec un environnement spécifique FDT® appelé "application-cadre". Une application-cadre interagit avec un DTM à travers un ensemble d'interfaces FDT® normalisées.

Un fournisseur d'appareils peut développer un DTM pour chacun de ses appareils ou il peut développer un DTM pour un groupe d'appareils. Un DTM peut être utilisé pour accéder aux Paramètres de l'Appareil, configurer et exploiter l'appareil et diagnostiquer les problèmes. Un DTM peut aller d'une simple Interface Utilisateur Graphique (GUI) pour le réglage des Paramètres de l'Appareil à une application hautement sophistiquée pour effectuer des calculs complexes à des fins de diagnostic.

Les DTM peuvent être imbriqués afin de prendre en charge les Appareils Modulaires. L'imbrication de DTM permet également la prise en charge de hiérarchies de communication multiniveaux. Les appareils acheminés à travers différents protocoles de bus peuvent être connectés au moyen d'interfaces normalisées. Le DTM d'un appareil doit juste prendre en charge son propre protocole de communication. Les DTM de passerelles qui se connectent au DTM de l'appareil traitent de la transformation de protocole.

La spécification FDT® prend en charge un grand nombre de protocoles de bus, par exemple: PROFIBUS, HART, FOUNDATION Fieldbus, Interbus, AS-interface, IO-Link, DeviceNet et PROFINET IO.

En 1998, la phase de spécification a commencé dans le cadre de la "Zentralverband Elektrotechnik und Elektronikindustrie e. V."(ZVEI). En 1999, l'achèvement de la technologie a été accéléré lorsque la spécification a été adoptée par PROFIBUS Nutzerorganisation e. V. (PNO), qui a plus tard transféré les droits au "FDT Group AISBL". La technologie FDT® a été normalisée en tant que norme IEC 62453-1 en mai 2009.

4.4 Architecture unifiée OPC (OPC UA)

L'architecture unifiée OPC (OPC UA) est une norme indépendante de la plate-forme à travers laquelle différents types de systèmes et d'appareils peuvent communiquer par l'envoi de messages entre les clients et les serveurs sur différents types de réseaux. Elle prend en charge une communication robuste et sécurisée qui assure l'identité des clients et des serveurs et résiste aux attaques.

L'architecture unifiée OPC définit des ensembles normalisés de services que les serveurs peuvent fournir, et les serveurs individuels spécifient aux clients les ensembles de services qu'ils prennent en charge. Les services agissent sur un modèle d'objet qui est géré par le serveur et susceptible d'être découvert par un client. L'information est transmise en utilisant des types normalisés de données et des types de données définis par le fournisseur, et les serveurs définissent des modèles d'objets que les clients peuvent découvrir dynamiquement. Les serveurs peuvent fournir un accès à des données aussi bien actuelles qu'anciennes, ainsi que des alarmes et des événements pour signaler aux clients des modifications importantes.

L'architecture unifiée OPC peut être mappée à une variété de protocoles de communication et les données peuvent être encodées de différentes façons pour assurer un compromis entre portabilité et efficacité. Des transports et des codages relatifs aux services Web fondés sur le langage XML, ainsi qu'un format binaire de haute performance sont définis pour l'architecture unifiée OPC. L'abstraction de la norme de l'architecture unifiée OPC à partir de toute technologie particulière offre une pérennité qui permet le mappage de l'architecture unifiée OPC sur des technologies futures.

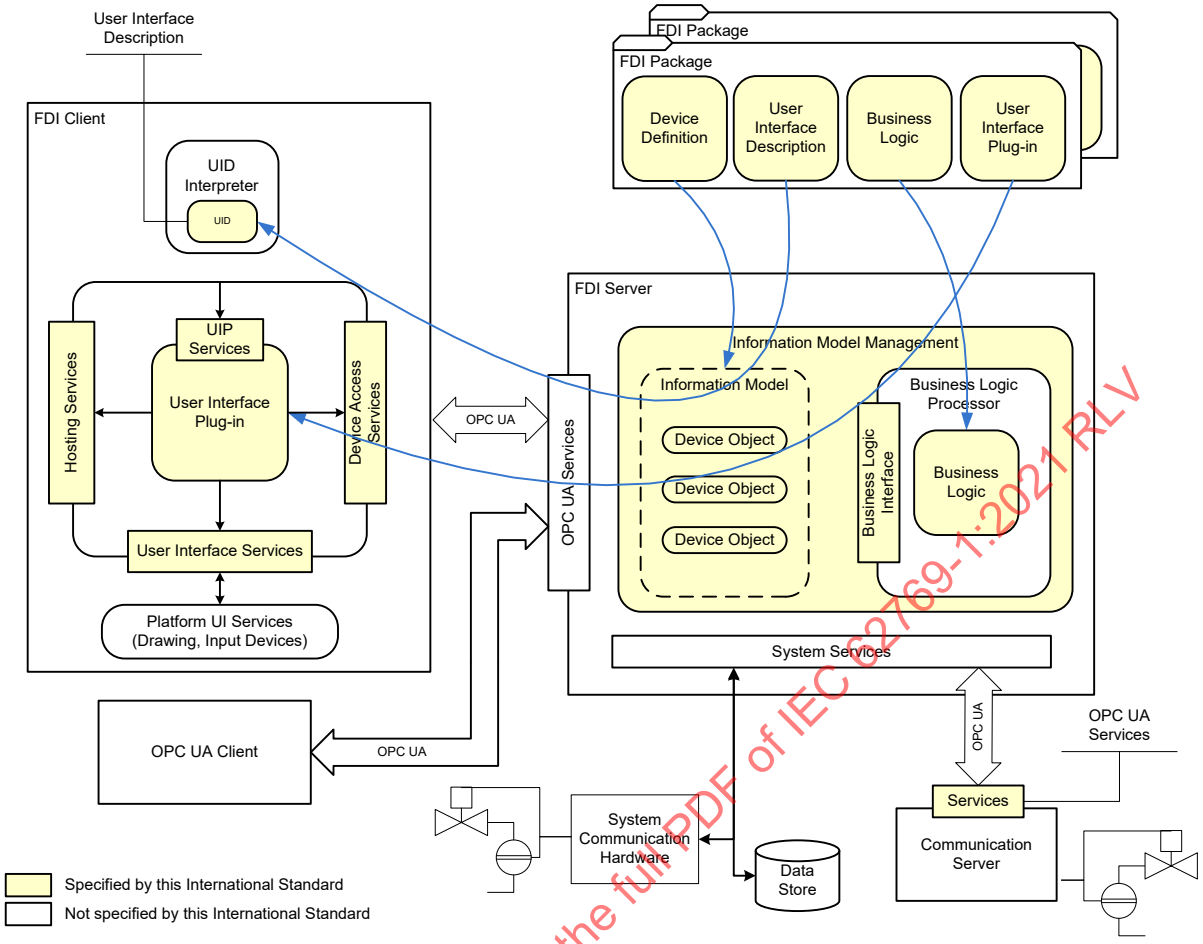
L'intégration des composants système comprend un facteur "comment" et un facteur "quoi". L'ensemble complet de services fourni par l'architecture unifiée OPC assure le facteur "comment" de l'intégration du système. L'architecture unifiée OPC fournit également les blocs de construction de base du facteur "quoi" de l'intégration du système en définissant un modèle d'objet extensible. D'autres organismes de normalisation, fournisseurs et utilisateurs finaux peuvent étendre ce modèle d'objet pour parvenir à une intégration étroite entre les composants du système.

L'OPC UA est normalisée dans l'IEC 62541.

5 Architecture

5.1 Vue d'ensemble

L'architecture FDI est constituée de Paquetages FDI, Clients FDI et Serveurs FDI, comme représenté à la Figure 1.



Anglais	Français
User Interface Description	Description d'Interface Utilisateur
FDI Client	Client FDI
UID Interpreter	Interpréteur d'UID
UIP Services	Services d'UIP
User Interface Plug-in	Plugiciel d'Interface Utilisateur
User Interface Services	Services d'Interface Utilisateur
Hosting Services	Services d'Hébergement
Device Access Services	Services d'Accès à l'Appareil
Platform UI Services (Drawing, Input Devices)	Services d'Interface Utilisateur (UI) de plate-forme (Dessin, Appareils d'Entrée)
FDI Package	Paquetage FDI
Device Definition	Définition d'Appareil
User Interface Description	Description d'Interface Utilisateur
Business Logic	Logique Applicative
FDI Server	Serveur FDI
Information Model Management	Gestion du Modèle d'Information
Information Model	Modèle d'Information
Device Object	Objet d'Appareil
Business Logic Interface	Interface de la Logique Applicative
Business logic Processor	Processeur de la Logique Applicative
System Services	Services système