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Field Device Integration (FDI)® – Part 103-4: PROFINET

Intégration des appareils de terrain (FDI)® – Partie 103-4: PROFINET

IEC 62769-103-4:2023-04(en-fr)

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Field Device Integration (FDI)® – Part 103-4: PROFINET

Intégration des appareils de terrain (FDI)® – Partie 103-4: PROFINET

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIELD DEVICE INTEGRATION (FDI®) –

Part 103-4: PROFINET

FOREWORD

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IEC 62769-103-4 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

a) added DeviceType to ProfinetIdentificationT;
b) added namespace to Annex A and Annex B;
c) added mapping rule for Device type when running in profile mode;
d) replaced GSD file with GSDML file, detailing of device type mapping;
e) added mapping to PA DIM.

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

Draft	Report on voting
65E/863/CDV	65E/920/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

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- withdrawn,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

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FIELD DEVICE INTEGRATION (FDI®) –

Part 103-4: PROFINET

1 Scope

This part of IEC 62769 specifies an FDI®[1] profile of IEC 62769 for IEC 61784-2_CP 3/4, IEC 61784-2_CP3/5 and IEC 61784-2_CP3/6 (PROFINET[2]).

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 61158-5-10, *Industrial communication networks – Fieldbus specifications – Part 5-10: Application layer service definition – Type 10 elements*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 61804 (all parts), *Devices and integration in enterprise systems – Function blocks (FB) for process control and electronic device description language (EDDL)*

IEC 62541-100:2015, *OPC unified architecture – Part 100: Device Interface*

IEC 62769-2, *Field device integration (FDI®) – Part 2: Client*

IEC 62769-4, *Field device integration (FDI®) – Part 4: FDI® Packages*

IEC 62769-5, *Field device integration (FDI®) – Part 5: Information Model*

IEC 62769-6, *Field device integration (FDI®) – Part 6: Technology Mapping*

IEC 62769-7, *Field device integration (FDI®) – Part 7: Communication devices*

PI Order No.: 2.122:2008, *Specification for PROFIBUS – Device Description and Device Integration – Volume 1: GSD, V5.1, July 2008: GSD;* available at <www.PROFIBUS.com>

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PI Order No.: 2.352:2014, *GSDML Specification for PROFINET IO;* available at <www.PROFIBUS.com>

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61158-5-10, IEC 61784-2, IEC 61804 (all parts), IEC 62541-100, IEC 62769-2, IEC 62769-4, IEC 62769-5, IEC 62769-6, IEC 62769-7 and PI Order No.: 2.352:2014 apply.

ISO and IEC maintain terminology 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

3.2 Abbreviated terms and acronyms

For the purposes of this document, the following abbreviated terms and acronyms apply:

DCP	Discovery and basic configuration protocol (see IEC 61158-5-10)
DNS	Domain name system
EDD	Electronic Device Description
EDDL	Electronic Device Description Language (see IEC 61804 (all parts))
GSD	General station description (see PI Order No.: 2.122:2008)
GSDML	GSD markup language (see PI Order No.: 2.352:2014)
IP	Internet protocol (IETF RFC 791)
UIP	User Interface plug-in
UUID	Universal unique identifier (see ISO/IEC 11578)
XML	Extensible markup language (see REC-xml-20081126)

4 Conventions

4.1 EDDL syntax

This document specifies content for the EDD component that is part of FDI® Communication Packages. The specification content using EDDL syntax uses the font Courier New. The EDDL syntax is used for method signature, variable, data structure and component declarations.

4.2 XML syntax

XML syntax examples use the font Courier New. The XML syntax is used to describe XML document schema.

Example: `<xs:simpleType name="ExampleType">`

4.3 Capitalizations

The IEC 62769 series uses capitalized terms to emphasize that these terms have an FDI® specific meaning.

Some of these terms using an acronym as a prefix for example

- FDI® Client, or
- FDI® Server.

Some of these terms are compound terms such as:

- Communication Servers, or
- Profile for Package.

Parameter names or attributes are concatenated to a single term, where the original terms starting in this term with a capital letter such as:

- ProtocolSupportFile, or
- ProtocolType.

Parameter names or attributes can also be constructed by using an underscore character to concatenate two or more terms such as:

- PROFILE_ID, or
- Profinet_PA_Network

5 Profile for PROFINET

5.1 General

This profile document to the FDI® specification in IEC 62769 specifies the protocol specifics needed for FDI® Packages describing Communication Servers, Gateways and Devices.

For Communication Servers this document defines also protocol specifics as these need to be considered in the Communication Servers hosted Information Model.

Annex B defines the XML schema for Direct Access Services. Annex C provides an overview of mapping PROFIBUS standard parameters to PA DIM.

5.2 Catalog profile

5.2.1 Protocol support file

5.2.1.1 FDI® Device Package

A GSDML file is a mandatory Attachment for FDI® Device Packages representing PROFINET IO devices.

Protocol specific attachments are mentioned in the Package Catalog as defined in IEC 62769-5. A communication feature list mark-up language (GSDML) file according to PI Order No.: 2.352:2014 is a mandatory attachment for FDI® Device Packages representing PROFINET devices. Table 1 specifies the parameters of ProtocolSupportFile in the FDI® Device Package.

Table 1 – ProtocolSupportFile for FDI® Device Packages

Parameter	Description
Content Type	text/xml
Root Namespace	Empty
Source Relationship	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename	According to PI Order No.: 2.352:2014.

5.2.1.2 FDI® Communication Package

A GSDML file as specified in ISO 15745-4:2003,/AMD1, is an optional attachment for FDI® Communication Packages representing PROFINET IO devices. Table 2 specifies the parameters of ProtocolSupportFile for FDI® Communication Packages.

Table 2 – ProtocolSupportFile for FDI® Communication Packages

Parameter	Description
Content Type	text/xml
Root Namespace	Empty
Source Relationship	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename	According to PI Order No.: 2.352:2014

5.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT string for the Catalog XML schema. The PROFINET specific value shall be "profinet_io".

5.2.3 Profile device

A Profile Package shall provide the catalog values for profile devices, enabling the FDI® Server to leverage a generic device description, if a specific one is not available. The definitions in Table 3 focus on catalog content that is vendor independent.

Table 3 – Catalog values for profile devices

Element	Attribute	Content
PackageType	—	Profile
Manufacturer	—	Empty
DeviceModel	—	Allowed profile identifier values (PROFILE_ID) are provided by PROFIBUS & PROFINET International (PI). PI provides and maintains a XML file (Profile_ID_Table) containing the assignment of PROFILE_ID to profiles. It is available at <http://www.profibus.com/IM/Profile_ID_Table.xml> The file can be downloaded by any engineering or service tool whenever it's connected to the Internet. NOTE More information is provided in PI Order No.: 3.502 (I&M Profile) and related profile definitions referred therein. The string format shall be hexadecimal starting with 0x, e.g. '0x3D00'.

5.2.4 Protocol version information

IEC 62769-4 defines an element type named InterfaceT for the Catalog XML schema. The element type InterfaceT contains an element named Version which is supposed to provide

version information about the applied communication protocol profile. The value has to follow the IEC 62769-4 defined version information schema defined in the element type VersionT. Table 4 describes how to apply the currently known protocol versions defined by the non-profit consortium PROFIBUS & PROFINET International. The general rule is to apply the value “0” for parts of the version information according to IEC 62769-4 that are not used in currently known protocol versions.

Table 4 – Version mapping examples

Protocol / Version	InterfaceT Version value
PROFINET Version 2.3	2.3.0
NOTE 1 This Table is just an example since this document cannot foresee how future protocol versions will be defined. NOTE 2 The currently known PROFINET protocol revision information provides major and minor version information. Leading zeros are not considered in version value evaluation since only the actual decimal values are relevant.	

5.3 Associating a Package with a device

5.3.1 Device type identification mapping

The purpose of a device type identification mapping is to enable FDI® host systems to compare the scan result against the topology representation in the Information Model. FDI® host systems shall also be enabled to determine the FDI® Device Package that fits for a device entry contained in the scan result. This will enable the user of an FDI® host system to synchronize the Information Model with the actual installation.

The communication server implemented scan service (defined in 5.6.1.7) provides a scan result through an XML document (schema defined in Annex A).

The Gateway implemented scan service (defined in 5.6.2.7) provides a scan result by means of the Information Model that contains data structures created from EDD content as specified in 5.6.2.7.

Common for both ways of presenting the scan result is that scan results contain device type identification and device instance identification.

FDI® host systems comparing the actual network topology configuration against the topology representation in the Information Model shall be enabled to handle the following situations:

a) The physical Device instance identified at a specific device address is not logically present in the Information model (as Instance): Enable the FDI® Host system to find the appropriate FDI® Device package according to the device catalogue information.
b) The physical Device instance identified by the device address is logically present in the Information Model (as Instance): Enable the FDI® Host system to compare the device type information presented in the scan result (see the identification in Clause A.6 and 5.6.2.7) and the device type specific information of the Instance present in the Information Model.

The FDI® Device package contains device type identification information that can be compared to the scan result based on the Catalog Schema in IEC 62769-4 which defines the XML element (simple) type “DeviceModel” and “Manufacturer”. Both types are used in (complex) element types “Protocol” and “RegDeviceType”.

As a result of the FDI® Package deployment the FDI® Package information is then present in the Information Model as specified FunctionalGroup Identification containing VendorID and DeviceID (see 5.4.3).

If a device is used as a profile device, the DeviceID returned in the scan result does not fit to the DeviceID within the GSDML. In this case, DeviceType can be used to identify the FDI® Package based on the name of the device in the FDI® Package Catalog.

The mapping between different device identification data sources is described in Table 5. Since scan results provided by the Communication Server or Gateway can convey data that is produced by the device (firmware) the device type identification mapping shall be supported by providing corresponding data in the FDI® Device Package contained Catalog and Information Model.

Table 5 – Device identification information mapping

FDI® Device Package	Information Model	Communication Server provided scan result	Gateway provided scan result
Catalog specified type Manufacturer	FunctionalGroup: Identification Browse Name: VendorID	Element (path): ConnectionPoint/Identification Attribute: VendorID	COLLECTION ConnectionPoint. Identification.VendorID
Catalog specified type DeviceModel	FunctionalGroup: Identification Browse Name: DeviceID	Element (path): ConnectionPoint/Identification Attribute: DeviceID	COLLECTION ConnectionPoint. Identification.DeviceID

5.3.2 Device type revision mapping

IEC 62769-4 envisions a concept that allows determining the compatibility between an FDI® Device Package and a Device. IEC 62769-4 specifies a life cycle management process bearing on a single version information provided for the entire device.

PROFINET IO related specifications, for example PI Order No.: 2.352:2011 (GSDML) and PI Order No.: 3.502 (I&M), split the device revision into software and hardware related information. These specifications do not outline any rules whether the GSD, GSDML or I&M specified HARDWARE_REVISION is independent from SOFTWARE_REVISION.

The goal of 5.3.2 is to describe the translation rules between the PROFINET IO related specifications describing their way of providing version information and the IEC 62769-4 specified way of containing version information that can be compared against the version read from the device. The purpose is to determine compatibility between an FDI® Device Package and a Device. (Figure 1 depicts the problem).

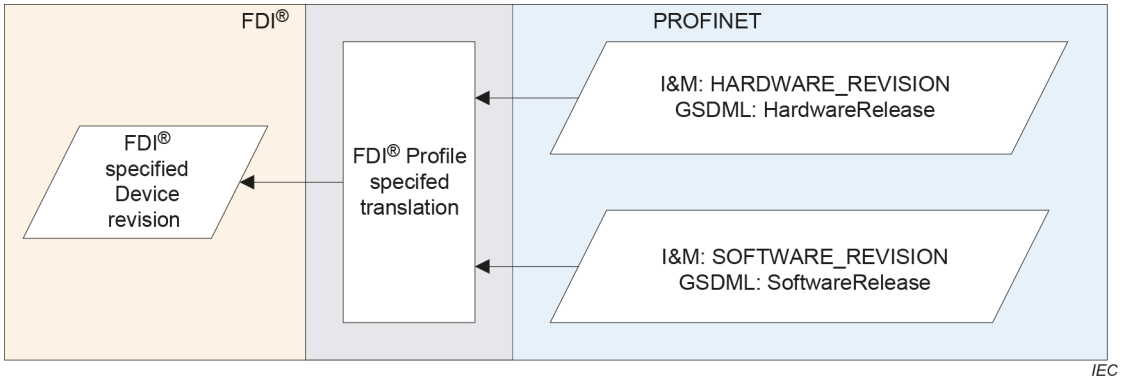

Figure 1 – Version mapping problem

The firmware of a device implements the data exchange interface which shall be described by means of the FDI® Device Package content (EDD). A device firmware that implements the GSD, GSDML or I&M profile enables reading the values SOFTWARE_REVISION and

HARDWARE_REVISION. The access to these values shall be described in the FDI® Device Package contained EDD.

Firmware modifications that affect the firmware implemented data exchange interface shall be reflected in the FDI® Device Package. Such firmware and device description modification shall be visible in the SOFTWARE_REVISION.

Hardware related modifications shall be captured in the HARDWARE_REVISION value. Hardware related modifications do not necessarily require always a firmware update. Thus HARDWARE_REVISION cannot be used to determine compatibility between a device and the FDI® Device Package. But if a hardware modification requires firmware modifications both HARDWARE_REVISION and SOFTWARE_REVISION shall be changed.

The IEC 62769-4 specifies the Catalog schema and an element DeviceVersion which is used in the element type declaration ListOfSupportedDeviceVersions. The value of DeviceVersion shall be compared to the device provided SOFTWARE_REVISION in order to determine the compatibility between an FDI® Device Package and a Device.

The data format for the SOFTWARE_REVISION is a string while the DeviceVersion expects three numbers for major, minor, and revision. Therefore the following rules apply: If the string has the format <integer>.<integer>.<integer> this is transferred to major, minor, and revision (in the same order). <integer> references to simple integer number in the string such as ‘1’ or ‘12’, not to other representations such as hexadecimal format (e.g. 0x001A). If <integer>.<integer> is provided, this is transferred to major and minor and ‘0’ is used for revision. If only an <integer> is provided, this is transferred to major and ‘0’ is used for minor and revision. A leading character or a leading character and whitespace shall be ignored. For a string in any other format the revision number shall not be considered to select the correct FDI® package.

5.4 Information Model mapping

5.4.1 ProtocolType definition

This standard refers to IEC 61158 specified protocols as these are relevant to support the device management related use cases supported through FDI® specifications. The scope is limited to data transport from the Information Model to the device.

For example, the device address management is based on services specified in the IEC 61158 series. But since the address management service is encapsulated by the IEC 62769-7 specified SetAddress service the details of IEC 61158 specified services do not need to be known.

The protocol type Profinet_IO shall be used to identify the PROFINET IO communication. The type Profinet_IO is a subtype of the abstract type ProtocolType (IEC 62541-100). Table 6 specifies the attributes and their values of the Protocol type Profinet_IO.

Table 6 – Protocol type Profinet_IO

Attribute	Value				
BrowseName	Profinet_IO				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Subtype of the ProtocolType defined in IEC 62541-100.					

5.4.2 DeviceType mapping

The properties mapping of the DeviceType node is defined in Table 7.

Table 7 – DeviceType Property mapping

Property	PROFINET Mapping
SerialNumber	SERIAL_NUMBER (see Table 8)
RevisionCounter	REV_COUNTER (see Table 8)
Manufacturer	String taken from FDI® package catalog (ManufacturerName from PackageT)
Model	String taken from FDI® package catalog (Name of DeviceTypeT, which is a localized name)
DeviceRevision	Not supported
DeviceManual	Not supported
SoftwareRevision	SOFTWARE_REVISION (see Table 8)
HardwareRevision	HARDWARE_REVISION (see Table 8)

5.4.3 FunctionalGroup identification definition

As defined in IEC 62541-100:2015, 5.3, each device representation in the FDI® Server hosted Information Model shall contain a protocol specific FunctionalGroup named Identification. The Parameters of this FunctionalGroup are defined for PROFINET as follows:

Table 8 – PROFINET identification type definition

BrowseName	DataType	Mandatory/Optional
VendorID	UInt16	Mandatory
DeviceID	UInt16	Mandatory
ORDER_ID	String	Mandatory
SERIAL_NUMBER	String	Mandatory
HARDWARE_REVISION	UInt16	Mandatory
SOFTWARE_REVISION	String	Mandatory
REV_COUNTER	UInt16	Mandatory
PROFILE_ID	UInt16	Mandatory
PROFILE_SPECIFIC_TYPE	UInt16	Mandatory
IM_VERSION	ByteString	Mandatory
IM_SUPPORTED	UInt16	Mandatory
DeviceType	String	Optional

The BaseDataVariable instances shall be created from VARIABLE declarations with identifiers that correspond to the browse names listed in Table 8 except the attributes VendorID and DeviceID. The related attribute values shall be taken from the GSD file (5.2.1). The element names VendorID and DeviceID match with the attribute names defined in the GSDML specification.