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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

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CONTENTS

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FIELD DEVICE INTEGRATION (FDI®) –

Part 103-4: ~~Profiles –~~ PROFINET

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 62769-103-4:2020. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

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- withdrawn,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

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

FIELD DEVICE INTEGRATION (FDI®) –

Part 103-4: ~~Profiles –~~ PROFINET

1 Scope

This part of IEC 62769 specifies an FDI®[1] profile of IEC 62769 for IEC 61784-2_CP3/4, 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~~/IEEE~~ 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: ~~FDI~~ Client*

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: ~~FDI~~ 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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1 FDI is a registered trademark of the non-profit organization Fieldbus Foundation, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

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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 ~~conventions~~ 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~~:2006~~, 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.

a) 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).

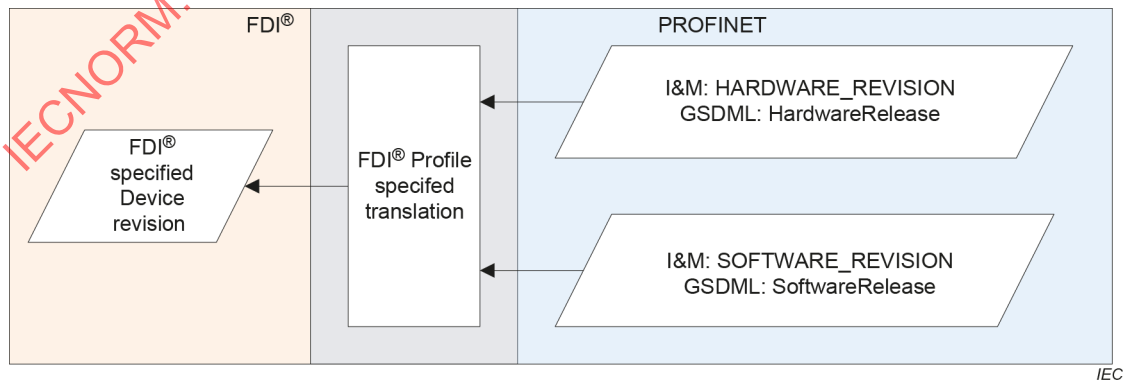

Figure 1 – Version mapping problem

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.

5.5 Topology elements

5.5.1 ConnectionPoint definition

In order to support different network topology engineering needs related to different protocol layers used for PROFINET IO the ConnectionPoint type definitions follow the IEC 62769-7 given recommendations about how to handle address information for protocol layers embedded in PROFINET IO.

The ConnectionPoint type ConnectionPoint_Profinet_IO shall be used to parameterize PROFINET IO network access points. The ConnectionPoint type Profinet_IO is a subtype of the abstract type ConnectionPointType (IEC 62769-5). Table 9 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profinet_IO.

Table 9 – ConnectionPoint type for Profinet_IO

Attribute	Value				
BrowseName	Profinet_IO				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Subtype of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	MAC	Octet[6]	PropertyType	Mandatory
HasProperty	Variable	IPv4	Octet[4]	PropertyType	Mandatory
HasProperty	Variable	DNSNAME	String	PropertyType	Mandatory
HasProperty	Variable	VALID	Boolean	PropertyType	Mandatory

The ConnectionPoint type Profinet_IO shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a PROFINET IO network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint.

Variable MAC is an array of 6 bytes holding the MAC address. The value is a unique identifier assigned to network interfaces that support IEEE 802.3 specified communication. The value can only be read from the device for example during execution of the scan service.

Variable IPv4 is an array of 4 bytes holding the IP-Address.

NOTE 1 Formatting of an IP-Address results typically in a character string that consists of four "." separated, 1..3-digit decimal numbers (example 128.12.1.15). The EDDL specification according to IEC 61804-3 and IEC 61804-4 does not support formatting instructions for the OCTECT type. But since semantics of the VARIABLE definitions made in this part of IEC 62769 are defined, it is assumed that system can render VARIABLE values accordingly.

Variable DNSNAME holds the station name. The station name syntax shall follow the Domain Name System (DNS) related specifications.

NOTE 2 The Domain Name System (DNS) is a hierarchical naming system that translates domain names meaningful to humans into the numerical identifiers associated with networking equipment for the purpose of locating and addressing these devices. The specifications of the rules for forming domain names appear in IETF RFC 1035, IETF RFC 1123 and IETF RFC 2181.

The Variable Valid indicates whether the stored address information is valid.

```
COMPONENT ConnectionPoint_PROFINET_IO
{
  LABEL "PROFINET IO Connection point";
  CAN_DELETE FALSE;
  PROTOCOL PROFINET;
}

VARIABLE MAC
{
  LABEL "MAC address";
  HELP "Unique network visible device identifier";
  CLASS DEVICE;
  TYPE OCTET(6);
  HANDLING READ;
  CLASS LOCAL;
}

VARIABLE IPv4
{
  LABEL "IP Address";
  HELP "IP v4 address";
  CLASS DEVICE;
  TYPE OCTET(4);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

VARIABLE DNS_Name
{
  LABEL "DNS Name";
  HELP "Station name";
  CLASS DEVICE;
  TYPE BITSTRING(256);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

COLLECTION ConnectionPoint
{
  LABEL "PROFINET Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_MAC, MAC;
    CONNECTION_POINT_IPV4, IPv4;
    CONNECTION_POINT_DNS_NAME, DNS_Name;
  }
}
```


5.5.2 Communication Device definition

According to IEC 62769-7, each FDI® Communication Package shall contain an EDD element describing the device. The following EDDL source code is an example describing a Communication Server.

```
COMPONENT PROFINET_Communication_Server
{
  LABEL "PROFINET communication server";
  PRODUCT_URI "urn:PROFIBUS International: PROFINET Communication   Server";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    PROFINET_Communication_Device_Setup
  }
}

COMPONENT_RELATION PROFINET_Communication_Device_Setup
{
   LABEL "Relation between Device and communication device";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
       PROFINET_Communication_Device{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 2;
}
```

According to IEC 62769-7, each FDI® Communication Package shall contain at least one EDD element describing at least one communication device component. The following EDDL source code example shows how to describe a PROFINET IO communication device:

```
COMPONENT PROFINET_Communication_Device
{
  LABEL "PROFINET communication device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    Profinet_Service_Provider_Relation
  }
}

COMPONENT_RELATION Profinet_Service_Provider_Relation
{
   LABEL " Relation to communication service provider ";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
       PROFINET_Service_Provider{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 2;
}
```

In an actual communication device, the value “Profinet_Service_Provider” needs to be adapted according to the identifier of the COMPONENT declaration that describes the communication service provider.

5.5.3 Communication service provider definition

According to IEC 62769-7, each FDI® Communication Package shall contain at least one EDD element describing at least one communication service provider component. The following EDDL source code example shows how to describe a PROFINET IO communication service provider component.

The component reference (ConnectionPoint_PROFINET_IO) corresponds to the related connection point definitions given in 5.5. The attribute BYTE_ORDER value is to be set according to the protocol.

```
COMPONENT PROFINET_Service_Provider
{
  LABEL "PROFINET communication service provider";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS
  {
    PROFINET_Service_Provider_Connection_Point_Relation
  }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION PROFINET_Service_Provider_Connection_Point_Relation
{
   LABEL "Relation between communication service provider and connection point";
   RELATION_TYPE CHILD_COMPONENT;
   ADDRESSING {DNS_Name}
   COMPONENTS
   {
       ConnectionPoint_PROFINET_IO{ AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 1;
}
```

5.5.4 Network definition

~~According to IEC 62769-7, each FDI Communication Package shall contain at least one EDD element~~ IEC 62769-7 describing network configuration constraints using the component construct.

```
COMPONENT Network_PROFINET
{
    LABEL "PROFINET IO Network";
    CAN_DELETE TRUE;
    CLASSIFICATION NETWORK_COMPONENT;
    COMPONENT_RELATIONS
    {
      PROFINET_IO_Network_Connection_Point_Relation
    }
}

COMPONENT_RELATION PROFINET_IO_Network_Connection_Point_Relation
{
   LABEL "Relation between network and connection point";
   RELATION_TYPE CHILD_COMPONENT;
   ADDRESSING {DNS_Name}
   COMPONENTS
   {
       ConnectionPoint_PROFINET_IO
   }
}
```


5.6 Methods

5.6.1 Methods for FDI® Communication Servers

5.6.1.1 General

The Communication Server contained Information Model shall implement services according to the method signatures described in 5.6.1.

5.6.1.2 Connect

Signature:

```
Connect(
   [in]   ByteString        CommunicationRelationId,
   [in]   String            DNSNAME,
   [in]   UInt16            DeviceID,
   [in]   UInt16            VendorID,
   [out]  Int32             ServiceError);
```

Table 10 provides the description of the arguments.

Table 10 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows finding the direct parent-child relation.
DNSNAME	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5. The argument value holds the device's network address.
DeviceID	The argument value holds the manufacturer defined device identification number. (See GSDML "Attributes of element DeviceIdentity".)
VendorID	The argument value holds the PNO defined manufacturer identification number. (See GSDML "Attributes of element DeviceIdentity".)
ServiceError	0: OK / execution finished, connection established successfully -1: Connect Failed / canceled by caller -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid DeviceID -6: Connect Failed / invalid ManufacturerID

Remarks: The ConnectionPoint defined for PROFINET IO holds more address attribute values than used for the connect service. The reason is that any exchange of record data with the device requires that address assignment is completed. Once address assignment is done the DNSNAME is sufficient to address the device. The MAC address could be used for device type and instance verification purpose but this has been already done during the address assignment.

5.6.1.3 Disconnect

Signature:

```
Disconnect(
   [in]   ByteString        CommunicationRelationId,
   [out]  Int32             ServiceError)
```

Table 11 provides the description of the arguments.

Table 11 – Method Disconnect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows to find the direct parent-child relation.
ServiceError	0: OK / disconnect finished successfully -1: Disconnect Failed / no existing communication relation -2: Disconnect Failed / invalid communication relation identifier

5.6.1.4 Transfer

Signature

```
Transfer(
       [in]   ByteString    CommunicationRelationId,
       [in]   String OPERATION,
       [in]   UInt16        SLOT,
       [in]   UInt16        SUBSLOT,
       [in]   UInt16        INDEX,
       [in]   UInt32 API,
       [in]   ByteString    REQUEST,
       [out]  ByteString    REPLY,
       [out]  ByteString    RESPONSE_CODES
       [out]  Int32  ServiceError);
```

Table 12 provides the description of the arguments.

Table 12 – Method Transfer arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
OPERATION	The argument value indicates the data transfer direction. Allowed values are “READ” and “WRITE”.
SLOT	The argument name shall match with the corresponding COMMAND – attribute name SLOT. The argument value shall come from the attribute value of COMMAND – attribute SLOT of the corresponding COMMAND that shall be processed.
SUBSLOT	The argument name shall match with the corresponding COMMAND – attribute name SUBSLOT. The argument value shall come from the attribute value of COMMAND – attribute SUBSLOT of the corresponding COMMAND that shall be processed.
INDEX	The argument name shall match with the corresponding COMMAND – attribute name INDEX. The argument value shall come from attribute value of COMMAND – attribute INDEX of the corresponding COMMAND that shall be processed.
API	The argument is not supported by current COMMAND description. The default value for this argument is 0.
REQUEST	The argument name shall match with the corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough the argument is created from definitions provided by the REQUEST element of the corresponding COMMAND that shall be processed.
REPLY	The argument name shall match with corresponding COMMAND sub-element name REPLY. The byte stream returned by this argument applies to definitions provided by the REPLY element of the corresponding COMMAND that shall be processed.
RESPONSE_CODES	The argument name shall match with the COMMAND sub-element name RESPONSE_CODES. The argument value conveys the PROFINET specific communication service response bytes.
ServiceError	0: OK / execution finished -1: Transfer Failed / canceled by caller -3: Transfer Failed / no existing communication relation -4: Transfer Failed / invalid communication relation identifier -5: Transfer Failed / invalid sendData content -6: Transfer Failed / invalid receiveData formatProfinet

5.6.1.5 GetPublishedData

This method is not supported by PROFINET IO.

5.6.1.6 SetAddress

Signature

```
SetAddress(
      [in]   byte[6]       MAC,
      [in]   byte[4]       IP,
      [in]   String DNSNAME,
      [in]   byte[4]       SubnetMask,
      [in]   byte[4]       Gateway,
      [out]  Int32  ServiceError);
```

Table 13 provides the description of the arguments.

Table 13 – Method SetAddress arguments

Argument	Description
MAC	The argument value holds the unique identifier of a device. The argument name matches with the name of Topology elements ConnectionPoint property MAC is defined in Table 9.
IP	The argument value holds the new IP address for a device. The argument name matches with the name of the Topology elements ConnectionPoint property IP is defined in Table 9.
DNSNAME	The argument value holds the new DNSNAME (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property DNSNAME is defined in Table 9.
SubnetMask	The argument value holds the new SubnetMask (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property SubnetMask is defined in Table 9.
Gateway	The argument value holds the new Gateway (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property Gateway is defined in Table 9.
ServiceError	0: OK / execution finished successfully -1: SetAddress Failed / canceled by caller -3: SetAddress Failed / not initialized -4: SetAddress Failed / not connected to a network -5: SetAddress Failed / no device found responding to MAC -6: SetAddress Failed / duplicate address error -7: SetAddress Failed / device did not accept new address -8: SetAddress Failed / invalid argument MAC -9: SetAddress Failed / invalid argument IP -10: SetAddress Failed / invalid argument DNSNAME -11: SetAddress Failed / invalid argument SubnetMask -12: SetAddress Failed / invalid argument Gateway -13: SetAddress Failed / not possible in status connected

The service SetAddress corresponds with the IEC 61158-5-10 specified DCP ASE service set.

5.6.1.7 Scan

The method signature specified in IEC 62769-7 applies. The corresponding topologyScanResult schema is specified in Annex A. The scan service maps to the PROFINET IO DCP ASE specified service Identify according to IEC 61158-5-10.

5.6.1.8 ResetScan

The method signature specified in IEC 62769-7 applies.

5.6.2 Methods for Gateways

5.6.2.1 General

The methods signatures defined in 5.6.2 shall apply. The methods shall be implemented in the EDD element (IEC 62769-4) contained in a Gateway related FDI® Package containing the communication device definitions.

5.6.2.2 Connect

Subclause 5.6.2.2 describes the PROFINET Gateway specific implementation of the service Connect specified in IEC 62769-7.

```
METHOD BeginConnect(
       DD_STRING     CommunicationRelationId,
       DD_STRING     DNSNAME,
       unsigned int  DeviceID,
       unsigned int  VendorID,
       unsigned long ServiceID,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndConnect(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceID,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelConnect(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceID,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 14 provides the description of the arguments.

Table 14 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows finding the direct parent-child relation.
DNSNAME	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5. The argument value holds the device's network address.
DeviceID	The argument value holds the manufacturer defined device identification number. (See GSDML "Attributes of element DeviceIdentity".)
VendorID	The argument value holds the PNO defined manufacturer identification number. (See GSDML "Attributes of element DeviceIdentity".)
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndConnect invocation cycle that shall not be faster than specified in the argument value.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndConnect 0: OK / execution finished, connection established successfully -1: Connect Failed / canceled by caller -2: Call Failed / unknown ServiceId -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid DeviceID -6: Connect Failed / invalid ManufacturerID

5.6.2.3 Disconnect

Subclause 5.6.2.3 describes the PROFINET specific implementation of the service Disconnect specified in IEC 62769-7.

```
METHOD Disconnect(
       DD_STRING     CommunicationRelationId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

All the arguments of the Disconnect method are described in Table 11.

5.6.2.4 Transfer

Subclause 5.6.2.4 describes the PROFINET specific implementation of the service Transfer specified in IEC 62769-7.

```
METHOD BeginTransfer(
       DD_STRING     CommunicationRelationId,
       DD_STRING     OPERATION,
       unsigned short       SLOT,
       unsigned short       SUBSLOT,
       unsigned short       INDEX,
       unsigned long        API,
       DD_STRING     REQUEST,
       DD_STRING     &REPLY,
       DD_STRING     &RESPONSE_CODES,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
```

```
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndTransfer(
       DD_STRING     CommunicationRelationId,
       DD_STRING     &REPLY,
       DD_STRING     &RESPONSE_CODES,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelTransfer(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 15 provides the description of the arguments.

Table 15 – Method Transfer arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
OPERATION	The argument value indicates data transfer direction. Allowed values are “READ” and “WRITE”.
SLOT	The argument name shall match with the corresponding COMMAND – attribute name SLOT. The argument value shall come from the attribute value of COMMAND – attribute SLOT of the corresponding COMMAND that shall be processed.
SUBSLOT	The argument name shall match with the corresponding COMMAND – attribute name SUBSLOT. The argument value shall come from the attribute value of COMMAND – attribute SUBSLOT of the corresponding COMMAND that shall be processed.
API	The argument is not supported by the current COMMAND description. The default value for this argument is 0.
INDEX	The argument name shall match with the corresponding COMMAND – attribute name INDEX. The argument value shall come from the attribute value of COMMAND – attribute INDEX of the corresponding COMMAND that shall be processed.
REQUEST	The argument name shall match with the corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough the argument is created from definitions provided by the REQUEST element of the corresponding COMMAND that shall be processed.
REPLY	The argument name shall match with the corresponding COMMAND sub-element name REPLY. The byte stream returned by this argument applies to definitions provided by the REPLY element of the corresponding COMMAND that shall be processed.
RESPONSE_CODES	The argument name shall match with the COMMAND sub-element name RESPONSE_CODES. The argument value conveys the PROFINET specific communication service response bytes.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.

Argument	Description
ServiceError	1: OK / function started asynchronously, result has to be polled with EndTransfer 0: OK / execution finished -1: Transfer Failed / canceled by caller -2: Call Failed / unknown service ID -3: Transfer Failed / no existing communication relation. -4: Transfer Failed / invalid communication relation identifier -5: Transfer Failed / invalid sendData content -6: Transfer Failed / invalid receiveData formatProfinet

5.6.2.5 GetPublishedData

This method is not supported in PROFINET.

5.6.2.6 SetAddress

Subclause 5.6.2.6 describes the PROFINET specific implementation of the service SetAddress specified in IEC 62769-7.

```
METHOD BeginSetAddress(
       DD_STRING     MAC,
       DD_STRING     IP,
       DD_STRING     DNSNAME,
       DD_STRING     SubnetMask,
       DD_STRING     Gateway,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndSetAddress(
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelSetAddress(
       unsigned long ServiceId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 16 provides the description of the arguments.

Table 16 – Method SetAddress arguments

Argument	Description
MAC	The argument value holds the unique identifier of a device. The argument name matches with the name of Topology elements ConnectionPoint property MAC is defined in Table 9.
IP	The argument value holds the new IP address for a device. The argument name matches with the name of Topology elements ConnectionPoint property IP is defined in Table 9.
DNSNAME	The argument value holds the new DNSNAME (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property DNSNAME is defined in Table 9.
SubnetMask	The argument value holds the new SubnetMask (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property SubnetMask is defined in Table 9.
Gateway	The argument value holds the new Gateway (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property Gateway is defined in Table 9.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndSetAddress 0: OK / execution finished successfully -1: SetAddress Failed / canceled by caller -2: Call Failed / unknown service ID -3: SetAddress Failed / not initialized -4: SetAddress Failed / not connected to a network -5: SetAddress Failed / no device found responding to MAC -6: SetAddress Failed / duplicate address error -7: SetAddress Failed / device did not accept new address -8: SetAddress Failed / invalid argument MAC -9: SetAddress Failed / invalid argument IP -10: SetAddress Failed / invalid argument DNSNAME -11: SetAddress Failed / invalid argument SubnetMask -12: SetAddress Failed / invalid argument Gateway -13: SetAddress Failed / not possible in status connected

5.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The PROFINET gateway business logic shall create the scan result following IEC 62769-7. The following definitions shall be present in the COMPONENT declaration that holds the definitions for a communication device. The data structure corresponds to the data structure defined in the XML schema described in Annex A. The SCAN_LIST attribute inside COMPONENT declaration shall refer to LIST TopologyScanResult.

```
VARIABLE mDNSName
{
  LABEL "Device station name";
  TYPE BITSTRING(256);
  CLASS LOCAL;
}


VARIABLE mMAC
{
  LABEL "Device MAC Address";
TYPE OCTET(6);
  CLASS LOCAL;
}

VARIABLE mIPv4
{
  LABEL "Device IP Address";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mSubnetMask
{
  LABEL "Subnet mask";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mGateway
{
  LABEL "Gateway IP Address";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mVendorID
{
  LABEL "Manufacturer identification";
  TYPE UNSIGNED_INTEGER(4);
  CLASS LOCAL;
}

VARIABLE mDeviceID
{
  LABEL "Manufacturer's Device identification";
  TYPE UNSIGNED_INTEGER(4);
  CLASS LOCAL;
}

COLLECTION ProfinetIdentificationType
{
  MEMBERS
  {
    VendorID, mVendorID;
    DeviceID, mDeviceID;
  }
}

COLLECTION ConnectionPoint
{
  MEMBERS
  {
    MAC, mMAC;
    IPv4, mIPv4;
    DNSName, mDNSName;
    SubnetMask, mSubnetMask;
    Gateway, mGateway;
    Identification, ProfinetIdentificationType;
  }
```

```
}


LIST Network
{
  TYPE ConnectionPoint;
}
```

5.6.2.8 ScanNext

The method signature specified in IEC 62769-7 applies. The PROFIBUS gateway business logic shall create the scan result following IEC 62769-7. Method ScanNext stores the result into data structures described for the method Scan (5.6.2.7).

Annex A
(normative)

Topology scan schema

A.1 General

The topology scan result schema specified in Annex A describes the PROFINET specific format Method Scan argument `topologyScanResult`. The XML document content and structure shall correspond to the Information Model designed concept to describe a topology in order to enable generic matching between physical devices connected to the network and the FDI® Server hosted Information Model.

A.2 Target Namespace

The target namespace defined for the scan result is defined by:

```
<xs:schema
   xmlns:PI="http://PI/2012/FDI/PROFILE/PROFINET"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
   targetNamespace="http://PI/2012/FDI/PROFILE/PROFINET"
   elementFormDefault="unqualified" version="1.1.0">
```

A.3 Network

The subsequent element is used to return the scan result corresponding to the Information Model described in IEC 62769-5.

The XML schema for a Network element is:

```
<xs:element name="Network" type="PI:ProfinetNetworkT"/>
```

A.4 ProfinetNetworkT

The XML schema for a ProfinetNetworkT type is:

```
<xs:complexType name="ProfinetNetworkT">
   <xs:sequence maxOccurs="unbounded">
      <xs:element name="ConnectionPoint"
         type="PI:ProfinetConnectionPointT"/>
   </xs:sequence>
</xs:complexType>
```

The elements of a ProfinetNetworkT type are described in Table A.1.

Table A.1 – Elements of ProfinetNetworkT

Element	Description
ConnectionPoint	The ConnectionPoint element holds the address and identification of the network connected device that has been found during bus scan operations.

A.5 ProfinetConnectionPointT

The XML schema for a ProfinetConnectionPointT type is:

```
<xs:complexType name="ProfinetConnectionPointT">
   <xs:sequence>
      <xs:element name="Identification"
         type="PI:ProfinetIdentificationT"/>
   </xs:sequence>
   <xs:attribute name="MAC" type="PI:MACT" use="required"/>
   <xs:attribute name="IPv4" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="DNSName" type="PI:DNSNameT" use="optional"/>
   <xs:attribute name="SubnetMask" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="Gateway" type="PI:IPv4T" use="optional"/>
</xs:complexType>
```

The attributes of a ProfinetConnectionPointT type are described in Table A.2.

Table A.2 – Attributes of ProfinetConnectionPointT

Attribute	Description
MAC	The attribute value holds the devices MAC address.
IPv4	The attribute value holds the IP/V4 address.
DNSname	The attribute holds the station name formatted after the "Domain Name System" (DNS).
SubnetMask	The attribute value holds the IP/V4 subnet mask.
Gateway	The attribute value holds the IP/V4 address of the gateway.

The elements of a ProfinetConnectionPointT type are described in Table A.3.

Table A.3 – Elements of ProfinetConnectionPointT

Element	Description
Identification	The Identification element holds the device type identification information of the network connected device that has been found during bus scan operations.

A.6 ProfinetIdentificationT

This type declaration corresponds partially to the "FunctionalGroup Identification".

The XML schema for a ProfinetIdentificationT type is:

```
<xs:complexType name="ProfinetIdentificationT">
   <xs:attribute name="VendorID" type="PI:Hex4DigitT" use="required"/>
   <xs:attribute name="DeviceID" type="PI:Hex4DigitT" use="required"/>
   <xs:attribute name="ORDER_ID" type="xs:string" use="optional"/>
   <xs:attribute name="SERIAL_NUMBER" type="xs:string"
      use="optional"/>
   <xs:attribute name="HARDWARE_REVISION" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="SOFTWARE_REVISION" type="xs:string"
      use="optional"/>
   <xs:attribute name="REV_COUNTER" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="PROFILE_ID" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="PROFILE_SPECIFIC_TYPE" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="IM_VERSION" type="xs:string" use="optional"/>
        <xs:attribute name="IM_SUPPORTED" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="DeviceType" type="xs:string" use="optional">
</xs:complexType>
```

The attributes of a ProfinetIdentificationT type are described in Table A.4.

Table A.4 – Attributes of ProfinetIdentificationT

Attribute	Description
VendorID	The attribute value contains the vendor specific part of the device identification number (DeviceIdentNumber) as defined in IEC 61158-5-10. The attribute corresponds to the GSDML defined attribute "VendorID".
DeviceID	The attribute value contains the device specific part of the device identification number (DeviceIdentNumber). The attribute corresponds to the GSDML defined attribute "DeviceID".
ORDER_ID	See Table 8
SERIAL_NUMBER	See Table 8
HARDWARE_REVISION	See Table 8
SOFTWARE_REVISION	See Table 8
REV_COUNTER	See Table 8
PROFILE_ID	See Table 8
PROFILE_SPECIFIC_TYPE	See Table 8
IM_VERSION	See Table 8
IM_SUPPORTED	See Table 8
DeviceType	See Table 8 DeviceType shall only be used, if FDI® Technology version of the FDI® Server and the FDI® Communications server is greater or equal to 1.3.0.

A.7 MACT

The XML schema for a MACT type is:

```
<xs:simpleType name="MACT">
   <xs:restriction base="xs:string">
      <xs:pattern value="([0-9a-fA-F][0-9a-fA-F]:){5}([0-9a-fA-F][0-
         9a-fA-F])"/>
   </xs:restriction>
</xs:simpleType>
```

A.8 IPv4T

The XML schema for an IPv4T type is:

```
<xs:simpleType name="IPv4T">
   <xs:restriction base="xs:string">
      <xs:pattern value="((25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-
         9])\.){3}(25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])"/>
   </xs:restriction>
</xs:simpleType>
```

A.9 IPv6T

The XML schema for an IPv6T type is:

```
<xs:simpleType name="IPv6T">
   <xs:restriction base="xs:string">
    <xs:pattern value="(([A-Fa-f0-9]{1,4}:){7}[A-Fa-f0-9]{1,4})"/>
   </xs:restriction>
</xs:simpleType>
```

A.10 DNSNameT

The XML schema for a DNSNameT type is:

```
<xs:simpleType name="DNSNameT">
   <xs:restriction base="xs:string">
      <xs:pattern value="[0-9a-zA-Z]([0-9a-zA-Z\-]{0,61}[0-9a-zA-
         Z])?(\.[0-9a-zA-Z]([0-9a-zA-Z\-]{0,61}[0-9a-zA-Z])?)*"/>
   </xs:restriction>
</xs:simpleType>
```

A.11 Hex4DigitT

The XML schema for a Hex4DigitT type is:

```
<xs:simpleType name="Hex4DigitT">
   <xs:restriction base="xs:string">
      <xs:pattern value="[0][x][0-9a-fA-F]{1,4}"/>
   </xs:restriction>
</xs:simpleType>
```

Annex B
(normative)

Transfer service parameters

B.1 General

Direct Access Services specified in IEC 62769-2 enable the User Interface Plug-in (UIP) to directly exchange data with the device. Direct data exchange means that data exchanged between a device and a UIP is not reflected in the Information Model. The IEC 62769-6 defined interface IDirectAccess corresponds to the IEC 62769-2 specified Direct Access Services. Interface IDirectAccess defined functions BeginTransfer and EndTransfer need to convey protocol specific information. The protocol specifics shall be captured in an XML document. The following specifies the XML document schema.

B.2 Target Namespace

The target namespace defined for the transfer service parameters document is defined in Clause A.2.

B.3 sendData

The element described in the following contains data to be submitted through the IDirectAccess function BeginTransfer defined argument sendData.

The XML schema for a sendData element is:

```
<xs:element name="sendData" type="PI:TransferSendDataT"/>
```

B.4 receiveData

The element described in the following contains data that is returned through the IDirectAccess function EndTransfer defined return value.

The XML schema for a receiveData element is:

```
<xs:element name="receiveData" type="PI:TransferResultDataT"/>
```

B.5 TransferSendDataT

A complex type that defines the service parameter data format that shall be applied to Transfer defined argument sendData.

The XML schema for a TransferSendDataT type is:

```
<xs:complexType name="TransferSendDataT">
   <xs:attribute name="OPERATION" type="PI:OperationT"
      use="required"/>
   <xs:attribute name="SLOT" type="xs:unsignedShort" use="required"/>
   <xs:attribute name="SUBSLOT" type="xs:unsignedShort"
      use="required"/>
   <xs:attribute name="INDEX" type="xs:unsignedShort" use="required"/>
   <xs:attribute name="API" type="xs:unsignedInt" use="required"/>
   <xs:attribute name="REQUEST" type="xs:hexBinary" use="required"/>
</xs:complexType>
```

The attributes of a TransferSendDataT type are described in Table B.1.

Table B.1 – Attributes of TransferSendDataT

Attribute	Description
OPERATION	The attribute corresponds to the Transfer method argument OPERATION.
SLOT	The attribute corresponds to the Transfer method argument SLOT.
SUBSLOT	The attribute corresponds to the Transfer method argument SUBSLOT.
INDEX	The attribute corresponds to the Transfer method argument INDEX.
API	The attribute corresponds to the Transfer method argument API.
REQUEST	The attribute corresponds to the Transfer method argument REQUEST.

B.6 TransferResultDataT

A complex type that defines the service parameter data format that shall be applied to Transfer defined receivedData return value.

The XML schema for a TransferResultDataT type is:

```
<xs:complexType name="TransferResultDataT">
   <xs:attribute name="REPLY" type="xs:hexBinary" use="required"/>
   <xs:attribute name="RESPONSE_CODES" type="xs:hexBinary"
      use="required"/>
</xs:complexType>
```

The attributes of a TransferResultDataT type are described in Table B.2.

Table B.2 – Attributes of TransferResultDataT

Attribute	Description
REPLY	The attribute corresponds to the Transfer method argument REPLY.
RESPONSE_CODES	The attribute corresponds to the Transfer method argument RESPONSE_CODES.

B.7 OperationT

A simple type that defines possible service operations.

The XML schema for an OperationT enumeration type is:

```
<xs:simpleType name="OperationT">
   <xs:restriction base="xs:string">
      <xs:enumeration value="READ"/>
      <xs:enumeration value="WRITE"/>
   </xs:restriction>
</xs:simpleType>
```

Annex C
(informative)

Mapping to PA DIM

C.1 General

FCG TS62769-8 specifies how the internal view of a device model represented by the EDD can be transferred into an external view as an OPC-UA information model by mapping EDD constructs to OPC-UA objects. This Annex C gives an overview on the mapping of standard parameters defined in PROFIBUS PA Profile 3.02 and PROFIBUS/PROFINET Profile 4.01 to PA DIM.

C.2 Mapping table

Table C.1 specifies the parameters, for which a direct mapping exists. Other parameters as for example the manufacturer cannot be mapped directly. In these cases mapping tables can be used.

Table C.1 – Mapping from PN standard parameters to PA DIM

Usage	PA-DIM BrowsePath	IEC 61987 CDD	Mapping PROFIBUS PA Profile 4.0
Identification	SerialNumber	0112/2///61987#ABA951#007	PB.IM_Serial_Number
Identification	HardwareRevision	0112/2///61987#ABA926#006	PB.HARDWARE_REVISION
Identification	SoftwareRevision	0112/2///61987#ABA601#006	PB.SOFTWARE_REVISION
Identification	RevisionCounter	0112/2///61987#ABN603#001	PB.IM_Revision_Counter
Identification	ProductCode	0112/2///61987#ABA300#006	PB.OrderID
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	IM_Tag_Location
DeviceHealth	DeviceHealth	0112/2///61987#ABN972#001	NE107_STATUS
Administration	DisplayLanguage	0112/2///61987#ABN597#001	PB.LANGUAGE
Administration	DateOfLastChange	0112/2///61987#ABN604#001	LATEST_CHANGE
Identification	RevisionCounter	0112/2///61987#ABN603#001	PB.IM_Revision_Counter
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	IM_Tag_Location

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IEC 61804-4, *Function blocks (FB) for process control and Electronic Device Description Language (EDDL) – Part 4: EDD interpretation*

IEC 62769 (all parts), *Field device integration (FDI®)*

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

ISO 15745-4:2003/AMD 1, *Industrial automation systems and integration – Open systems application integration framework – Part 4: Reference description for Ethernet-based control systems – Amendment 1: PROFINET profiles*

IEEE Std 802.3, *IEEE Standard for Ethernet*

PI Order No.: 2.352:2011, *GSDML Specification for PROFINET IO,* available at <www.PROFIBUS.com>

~~PI Order No.: 3.502:2009, *Profile Guidelines – Part 1: Identification & Maintenance Function,* available at <www.profibus.com> [viewed 2018-11-27]~~

IETF RFC 791: *Internet Protocol*, available at <www.rfc-editor.org>

IETF RFC 1035: *Domain names – implementation and specification*, available at <www.rfc-editor.org>

IETF RFC 1123: *Requirements for Internet Hosts – Application and Support*, available at <www.rfc-editor.org>

IETF RFC 2181: *Clarifications to the DNS Specification*, available at www.rfc-editor.org

IEC 62769-103-4

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INTERNATIONAL STANDARD

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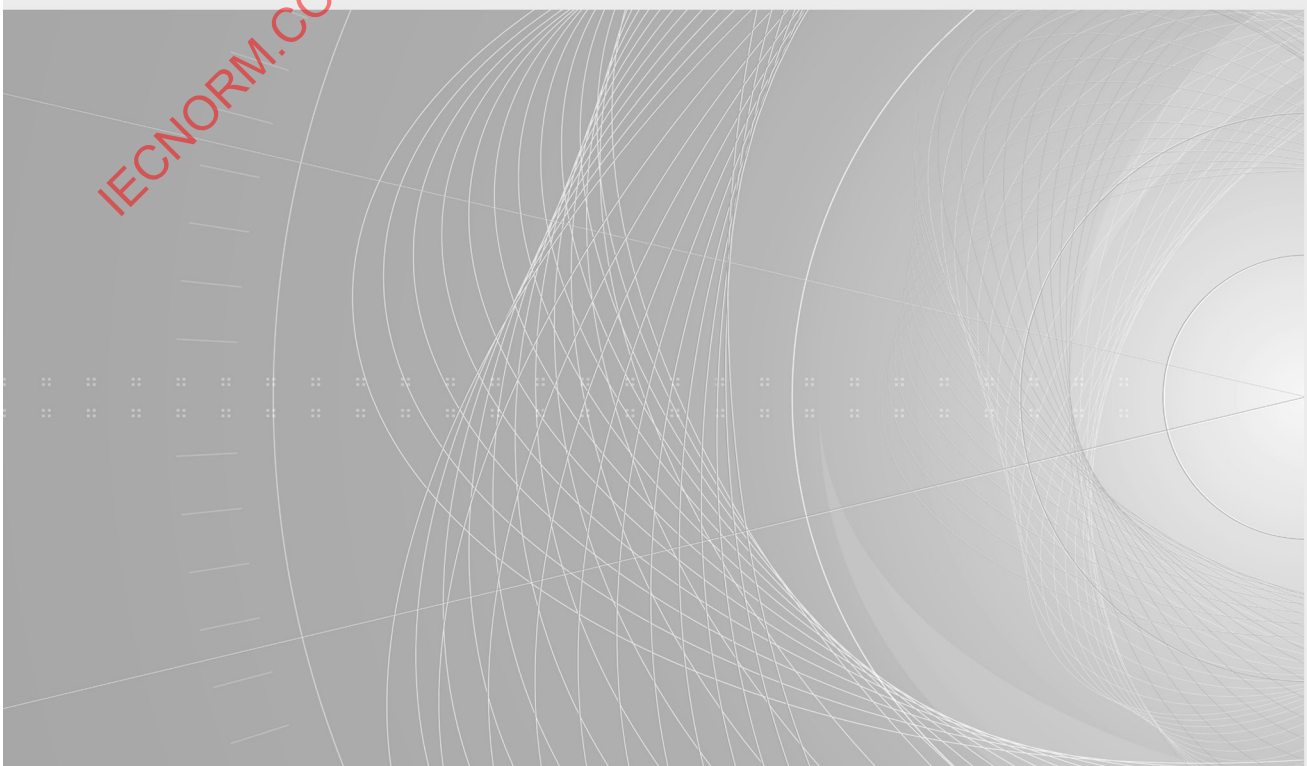

IEC 62769-103-4:2023-04(en-fr)

CONTENTS

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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

- reconfirmed,
- 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_CP3/4, 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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1 FDI is a registered trademark of the non-profit organization Fieldbus Foundation, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

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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).

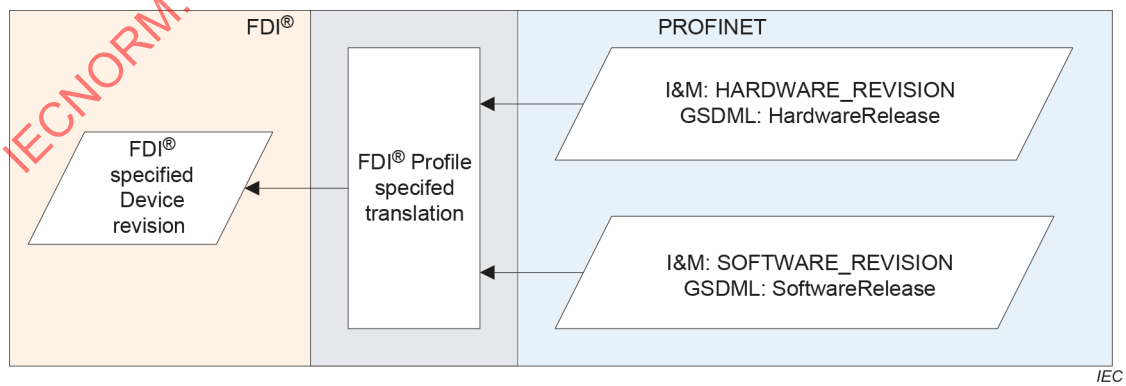

Figure 1 – Version mapping problem

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.

5.5 Topology elements

5.5.1 ConnectionPoint definition

In order to support different network topology engineering needs related to different protocol layers used for PROFINET IO the ConnectionPoint type definitions follow the IEC 62769-7 given recommendations about how to handle address information for protocol layers embedded in PROFINET IO.

The ConnectionPoint type ConnectionPoint_Profinet_IO shall be used to parameterize PROFINET IO network access points. The ConnectionPoint type Profinet_IO is a subtype of the abstract type ConnectionPointType (IEC 62769-5). Table 9 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profinet_IO.

Table 9 – ConnectionPoint type for Profinet_IO

Attribute	Value				
BrowseName	Profinet_IO				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Subtype of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	MAC	Octet[6]	PropertyType	Mandatory
HasProperty	Variable	IPv4	Octet[4]	PropertyType	Mandatory
HasProperty	Variable	DNSNAME	String	PropertyType	Mandatory
HasProperty	Variable	VALID	Boolean	PropertyType	Mandatory

The ConnectionPoint type Profinet_IO shall be described by an EDD element contained in a Communication Device related FDI® Package that can drive a PROFINET IO network. Actual ConnectionPoint properties are declared by VARIABLE constructs grouped together in a COLLECTION named ConnectionPoint.

Variable MAC is an array of 6 bytes holding the MAC address. The value is a unique identifier assigned to network interfaces that support IEEE 802.3 specified communication. The value can only be read from the device for example during execution of the scan service.

Variable IPv4 is an array of 4 bytes holding the IP-Address.

NOTE 1 Formatting of an IP-Address results typically in a character string that consists of four "." separated, 1..3-digit decimal numbers (example 128.12.1.15). The EDDL specification according to IEC 61804-3 and IEC 61804-4 does not support formatting instructions for the OCTECT type. But since semantics of the VARIABLE definitions made in this part of IEC 62769 are defined, it is assumed that system can render VARIABLE values accordingly.

Variable DNSNAME holds the station name. The station name syntax shall follow the Domain Name System (DNS) related specifications.

NOTE 2 The Domain Name System (DNS) is a hierarchical naming system that translates domain names meaningful to humans into the numerical identifiers associated with networking equipment for the purpose of locating and addressing these devices. The specifications of the rules for forming domain names appear in IETF RFC 1035, IETF RFC 1123 and IETF RFC 2181.

The Variable Valid indicates whether the stored address information is valid.

```
COMPONENT ConnectionPoint_PROFINET_IO
{
  LABEL "PROFINET IO Connection point";
  CAN_DELETE FALSE;
  PROTOCOL PROFINET;
}

VARIABLE MAC
{
  LABEL "MAC address";
  HELP "Unique network visible device identifier";
  CLASS DEVICE;
  TYPE OCTET(6);
  HANDLING READ;
  CLASS LOCAL;
}

VARIABLE IPv4
{
  LABEL "IP Address";
  HELP "IP v4 address";
  CLASS DEVICE;
  TYPE OCTET(4);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

VARIABLE DNS_Name
{
  LABEL "DNS Name";
  HELP "Station name";
  CLASS DEVICE;
  TYPE BITSTRING(256);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

COLLECTION ConnectionPoint
{
  LABEL "PROFINET Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_MAC, MAC;
    CONNECTION_POINT_IPV4, IPv4;
    CONNECTION_POINT_DNS_NAME, DNS_Name;
  }
}
```


5.5.2 Communication Device definition

According to IEC 62769-7, each FDI® Communication Package shall contain an EDD element describing the device. The following EDDL source code is an example describing a Communication Server.

```
COMPONENT PROFINET_Communication_Server
{
  LABEL "PROFINET communication server";
  PRODUCT_URI "urn:PROFIBUS International: PROFINET Communication   Server";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    PROFINET_Communication_Device_Setup
  }
}

COMPONENT_RELATION PROFINET_Communication_Device_Setup
{
   LABEL "Relation between Device and communication device";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
       PROFINET_Communication_Device{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 2;
}
```

According to IEC 62769-7, each FDI® Communication Package shall contain at least one EDD element describing at least one communication device component. The following EDDL source code example shows how to describe a PROFINET IO communication device:

```
COMPONENT PROFINET_Communication_Device
{
  LABEL "PROFINET communication device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    Profinet_Service_Provider_Relation
  }
}

COMPONENT_RELATION Profinet_Service_Provider_Relation
{
   LABEL " Relation to communication service provider ";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
       PROFINET_Service_Provider{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 2;
}
```

In an actual communication device, the value “Profinet_Service_Provider” needs to be adapted according to the identifier of the COMPONENT declaration that describes the communication service provider.

5.5.3 Communication service provider definition

According to IEC 62769-7, each FDI® Communication Package shall contain at least one EDD element describing at least one communication service provider component. The following EDDL source code example shows how to describe a PROFINET IO communication service provider component.

The component reference (ConnectionPoint_PROFINET_IO) corresponds to the related connection point definitions given in 5.5. The attribute BYTE_ORDER value is to be set according to the protocol.

```
COMPONENT PROFINET_Service_Provider
{
  LABEL "PROFINET communication service provider";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS
  {
    PROFINET_Service_Provider_Connection_Point_Relation
  }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION PROFINET_Service_Provider_Connection_Point_Relation
{
   LABEL "Relation between communication service provider and connection point";
   RELATION_TYPE CHILD_COMPONENT;
   ADDRESSING {DNS_Name}
   COMPONENTS
   {
       ConnectionPoint_PROFINET_IO{ AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 1;
}
```

5.5.4 Network definition

IEC 62769-7 describing network configuration constraints using the component construct.

```
COMPONENT Network_PROFINET
{
    LABEL "PROFINET IO Network";
    CAN_DELETE TRUE;
    CLASSIFICATION NETWORK_COMPONENT;
    COMPONENT_RELATIONS
    {
      PROFINET_IO_Network_Connection_Point_Relation
    }
}

COMPONENT_RELATION PROFINET_IO_Network_Connection_Point_Relation
{
   LABEL "Relation between network and connection point";
   RELATION_TYPE CHILD_COMPONENT;
   ADDRESSING {DNS_Name}
   COMPONENTS
   {
       ConnectionPoint_PROFINET_IO
   }
}
```

5.6 Methods

5.6.1 Methods for FDI® Communication Servers

5.6.1.1 General

The Communication Server contained Information Model shall implement services according to the method signatures described in 5.6.1.

5.6.1.2 Connect

Signature:

```
Connect(
   [in]   ByteString        CommunicationRelationId,
   [in]   String            DNSNAME,
   [in]   UInt16            DeviceID,
   [in]   UInt16            VendorID,
   [out]  Int32             ServiceError);
```

Table 10 provides the description of the arguments.

Table 10 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows finding the direct parent-child relation.
DNSNAME	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5. The argument value holds the device's network address.
DeviceID	The argument value holds the manufacturer defined device identification number. (See GSDML "Attributes of element DeviceIdentity".)
VendorID	The argument value holds the PNO defined manufacturer identification number. (See GSDML "Attributes of element DeviceIdentity".)
ServiceError	0: OK / execution finished, connection established successfully -1: Connect Failed / canceled by caller -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid DeviceID -6: Connect Failed / invalid ManufacturerID

Remarks: The ConnectionPoint defined for PROFINET IO holds more address attribute values than used for the connect service. The reason is that any exchange of record data with the device requires that address assignment is completed. Once address assignment is done the DNSNAME is sufficient to address the device. The MAC address could be used for device type and instance verification purpose but this has been already done during the address assignment.

5.6.1.3 Disconnect

Signature:

```
Disconnect(
   [in]   ByteString        CommunicationRelationId,
   [out]  Int32             ServiceError)
```

Table 11 provides the description of the arguments.

Table 11 – Method Disconnect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows to find the direct parent-child relation.
ServiceError	0: OK / disconnect finished successfully -1: Disconnect Failed / no existing communication relation -2: Disconnect Failed / invalid communication relation identifier

5.6.1.4 Transfer

Signature

```
Transfer(
       [in]   ByteString    CommunicationRelationId,
       [in]   String OPERATION,
       [in]   UInt16        SLOT,
       [in]   UInt16        SUBSLOT,
       [in]   UInt16        INDEX,
       [in]   UInt32 API,
       [in]   ByteString    REQUEST,
       [out]  ByteString    REPLY,
       [out]  ByteString    RESPONSE_CODES
       [out]  Int32  ServiceError);
```

Table 12 provides the description of the arguments.

Table 12 – Method Transfer arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
OPERATION	The argument value indicates the data transfer direction. Allowed values are “READ” and “WRITE”.
SLOT	The argument name shall match with the corresponding COMMAND – attribute name SLOT. The argument value shall come from the attribute value of COMMAND – attribute SLOT of the corresponding COMMAND that shall be processed.
SUBSLOT	The argument name shall match with the corresponding COMMAND – attribute name SUBSLOT. The argument value shall come from the attribute value of COMMAND – attribute SUBSLOT of the corresponding COMMAND that shall be processed.
INDEX	The argument name shall match with the corresponding COMMAND – attribute name INDEX. The argument value shall come from attribute value of COMMAND – attribute INDEX of the corresponding COMMAND that shall be processed.
API	The argument is not supported by current COMMAND description. The default value for this argument is 0.
REQUEST	The argument name shall match with the corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough the argument is created from definitions provided by the REQUEST element of the corresponding COMMAND that shall be processed.
REPLY	The argument name shall match with corresponding COMMAND sub-element name REPLY. The byte stream returned by this argument applies to definitions provided by the REPLY element of the corresponding COMMAND that shall be processed.
RESPONSE_CODES	The argument name shall match with the COMMAND sub-element name RESPONSE_CODES. The argument value conveys the PROFINET specific communication service response bytes.
ServiceError	0: OK / execution finished -1: Transfer Failed / canceled by caller -3: Transfer Failed / no existing communication relation -4: Transfer Failed / invalid communication relation identifier -5: Transfer Failed / invalid sendData content -6: Transfer Failed / invalid receiveData formatProfinet

5.6.1.5 GetPublishedData

This method is not supported by PROFINET IO.

5.6.1.6 SetAddress

Signature

```
SetAddress(
      [in]   byte[6]       MAC,
      [in]   byte[4]       IP,
      [in]   String DNSNAME,
      [in]   byte[4]       SubnetMask,
      [in]   byte[4]       Gateway,
      [out]  Int32  ServiceError);
```

Table 13 provides the description of the arguments.

Table 13 – Method SetAddress arguments

Argument	Description
MAC	The argument value holds the unique identifier of a device. The argument name matches with the name of Topology elements ConnectionPoint property MAC is defined in Table 9.
IP	The argument value holds the new IP address for a device. The argument name matches with the name of the Topology elements ConnectionPoint property IP is defined in Table 9.
DNSNAME	The argument value holds the new DNSNAME (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property DNSNAME is defined in Table 9.
SubnetMask	The argument value holds the new SubnetMask (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property SubnetMask is defined in Table 9.
Gateway	The argument value holds the new Gateway (station name) for a device. The argument name matches with the name of the Topology elements ConnectionPoint property Gateway is defined in Table 9.
ServiceError	0: OK / execution finished successfully -1: SetAddress Failed / canceled by caller -3: SetAddress Failed / not initialized -4: SetAddress Failed / not connected to a network -5: SetAddress Failed / no device found responding to MAC -6: SetAddress Failed / duplicate address error -7: SetAddress Failed / device did not accept new address -8: SetAddress Failed / invalid argument MAC -9: SetAddress Failed / invalid argument IP -10: SetAddress Failed / invalid argument DNSNAME -11: SetAddress Failed / invalid argument SubnetMask -12: SetAddress Failed / invalid argument Gateway -13: SetAddress Failed / not possible in status connected

The service SetAddress corresponds with the IEC 61158-5-10 specified DCP ASE service set.

5.6.1.7 Scan

The method signature specified in IEC 62769-7 applies. The corresponding topologyScanResult schema is specified in Annex A. The scan service maps to the PROFINET IO DCP ASE specified service Identify according to IEC 61158-5-10.

5.6.1.8 ResetScan

The method signature specified in IEC 62769-7 applies.

5.6.2 Methods for Gateways

5.6.2.1 General

The methods signatures defined in 5.6.2 shall apply. The methods shall be implemented in the EDD element (IEC 62769-4) contained in a Gateway related FDI® Package containing the communication device definitions.

5.6.2.2 Connect

Subclause 5.6.2.2 describes the PROFINET Gateway specific implementation of the service Connect specified in IEC 62769-7.

```
METHOD BeginConnect(
       DD_STRING     CommunicationRelationId,
       DD_STRING     DNSNAME,
       unsigned int  DeviceID,
       unsigned int  VendorID,
       unsigned long ServiceID,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndConnect(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceID,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelConnect(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceID,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 14 provides the description of the arguments.

Table 14 – Method Connect arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network which is directly connected to the communication server hardware. The nodeId allows finding the direct parent-child relation.
DNSNAME	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 5.5. The argument value holds the device's network address.
DeviceID	The argument value holds the manufacturer defined device identification number. (See GSDML "Attributes of element DeviceIdentity".)
VendorID	The argument value holds the PNO defined manufacturer identification number. (See GSDML "Attributes of element DeviceIdentity".)
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndConnect invocation cycle that shall not be faster than specified in the argument value.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndConnect 0: OK / execution finished, connection established successfully -1: Connect Failed / canceled by caller -2: Call Failed / unknown ServiceId -3: Connect Failed / device not found -4: Connect Failed / invalid device address -5: Connect Failed / invalid DeviceID -6: Connect Failed / invalid ManufacturerID

5.6.2.3 Disconnect

Subclause 5.6.2.3 describes the PROFINET specific implementation of the service Disconnect specified in IEC 62769-7.

```
METHOD Disconnect(
       DD_STRING     CommunicationRelationId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

All the arguments of the Disconnect method are described in Table 11.

5.6.2.4 Transfer

Subclause 5.6.2.4 describes the PROFINET specific implementation of the service Transfer specified in IEC 62769-7.

```
METHOD BeginTransfer(
       DD_STRING     CommunicationRelationId,
       DD_STRING     OPERATION,
       unsigned short       SLOT,
       unsigned short       SUBSLOT,
       unsigned short       INDEX,
       unsigned long        API,
       DD_STRING     REQUEST,
       DD_STRING     &REPLY,
       DD_STRING     &RESPONSE_CODES,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
```

```
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndTransfer(
       DD_STRING     CommunicationRelationId,
       DD_STRING     &REPLY,
       DD_STRING     &RESPONSE_CODES,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelTransfer(
       DD_STRING     CommunicationRelationId,
       unsigned long ServiceId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 15 provides the description of the arguments.

Table 15 – Method Transfer arguments

Argument	Description
CommunicationRelationId	The argument value contains the nodeId of the ConnectionPoint representing the connection between a device and a physical network within the Information Model.
OPERATION	The argument value indicates data transfer direction. Allowed values are “READ” and “WRITE”.
SLOT	The argument name shall match with the corresponding COMMAND – attribute name SLOT. The argument value shall come from the attribute value of COMMAND – attribute SLOT of the corresponding COMMAND that shall be processed.
SUBSLOT	The argument name shall match with the corresponding COMMAND – attribute name SUBSLOT. The argument value shall come from the attribute value of COMMAND – attribute SUBSLOT of the corresponding COMMAND that shall be processed.
API	The argument is not supported by the current COMMAND description. The default value for this argument is 0.
INDEX	The argument name shall match with the corresponding COMMAND – attribute name INDEX. The argument value shall come from the attribute value of COMMAND – attribute INDEX of the corresponding COMMAND that shall be processed.
REQUEST	The argument name shall match with the corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough the argument is created from definitions provided by the REQUEST element of the corresponding COMMAND that shall be processed.
REPLY	The argument name shall match with the corresponding COMMAND sub-element name REPLY. The byte stream returned by this argument applies to definitions provided by the REPLY element of the corresponding COMMAND that shall be processed.
RESPONSE_CODES	The argument name shall match with the COMMAND sub-element name RESPONSE_CODES. The argument value conveys the PROFINET specific communication service response bytes.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.

Argument	Description
ServiceError	1: OK / function started asynchronously, result has to be polled with EndTransfer 0: OK / execution finished -1: Transfer Failed / canceled by caller -2: Call Failed / unknown service ID -3: Transfer Failed / no existing communication relation. -4: Transfer Failed / invalid communication relation identifier -5: Transfer Failed / invalid sendData content -6: Transfer Failed / invalid receiveData formatProfinet

5.6.2.5 GetPublishedData

This method is not supported in PROFINET.

5.6.2.6 SetAddress

Subclause 5.6.2.6 describes the PROFINET specific implementation of the service SetAddress specified in IEC 62769-7.

```
METHOD BeginSetAddress(
       DD_STRING     MAC,
       DD_STRING     IP,
       DD_STRING     DNSNAME,
       DD_STRING     SubnetMask,
       DD_STRING     Gateway,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD EndSetAddress(
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

METHOD CancelSetAddress(
       unsigned long ServiceId,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 16 provides the description of the arguments.

Table 16 – Method SetAddress arguments

Argument	Description
MAC	The argument value holds the unique identifier of a device. The argument name matches with the name of Topology elements ConnectionPoint property MAC is defined in Table 9.
IP	The argument value holds the new IP address for a device. The argument name matches with the name of Topology elements ConnectionPoint property IP is defined in Table 9.
DNSNAME	The argument value holds the new DNSNAME (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property DNSNAME is defined in Table 9.
SubnetMask	The argument value holds the new SubnetMask (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property SubnetMask is defined in Table 9.
Gateway	The argument value holds the new Gateway (station name) for a device. The argument name matches with the name of Topology elements ConnectionPoint property Gateway is defined in Table 9.
ServiceId	The service transaction code establishes the relation between the service request and the corresponding response.
DelayForNextCall	The value specifies a delay time in ms to limit the EndTransfer invocation cycle that shall not be faster than specified in the argument value.
ServiceError	1: OK / function started asynchronously, result has to be polled with EndSetAddress 0: OK / execution finished successfully -1: SetAddress Failed / canceled by caller -2: Call Failed / unknown service ID -3: SetAddress Failed / not initialized -4: SetAddress Failed / not connected to a network -5: SetAddress Failed / no device found responding to MAC -6: SetAddress Failed / duplicate address error -7: SetAddress Failed / device did not accept new address -8: SetAddress Failed / invalid argument MAC -9: SetAddress Failed / invalid argument IP -10: SetAddress Failed / invalid argument DNSNAME -11: SetAddress Failed / invalid argument SubnetMask -12: SetAddress Failed / invalid argument Gateway -13: SetAddress Failed / not possible in status connected

5.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The PROFINET gateway business logic shall create the scan result following IEC 62769-7. The following definitions shall be present in the COMPONENT declaration that holds the definitions for a communication device. The data structure corresponds to the data structure defined in the XML schema described in Annex A. The SCAN_LIST attribute inside COMPONENT declaration shall refer to LIST TopologyScanResult.

```
VARIABLE mDNSName
{
  LABEL "Device station name";
  TYPE BITSTRING(256);
  CLASS LOCAL;
}


VARIABLE mMAC
{
  LABEL "Device MAC Address";
TYPE OCTET(6);
  CLASS LOCAL;
}

VARIABLE mIPv4
{
  LABEL "Device IP Address";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mSubnetMask
{
  LABEL "Subnet mask";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mGateway
{
  LABEL "Gateway IP Address";
  TYPE OCTET(4);
  CLASS LOCAL;
}

VARIABLE mVendorID
{
  LABEL "Manufacturer identification";
  TYPE UNSIGNED_INTEGER(4);
  CLASS LOCAL;
}

VARIABLE mDeviceID
{
  LABEL "Manufacturer's Device identification";
  TYPE UNSIGNED_INTEGER(4);
  CLASS LOCAL;
}

COLLECTION ProfinetIdentificationType
{
  MEMBERS
  {
    VendorID, mVendorID;
    DeviceID, mDeviceID;
  }
}

COLLECTION ConnectionPoint
{
  MEMBERS
  {
    MAC, mMAC;
    IPv4, mIPv4;
    DNSName, mDNSName;
    SubnetMask, mSubnetMask;
    Gateway, mGateway;
    Identification, ProfinetIdentificationType;
  }
```

```
}


LIST Network
{
  TYPE ConnectionPoint;
}
```

5.6.2.8 ScanNext

The method signature specified in IEC 62769-7 applies. The PROFIBUS gateway business logic shall create the scan result following IEC 62769-7. Method ScanNext stores the result into data structures described for the method Scan (5.6.2.7).

Annex A
(normative)

Topology scan schema

A.1 General

The topology scan result schema specified in Annex A describes the PROFINET specific format Method Scan argument `topologyScanResult`. The XML document content and structure shall correspond to the Information Model designed concept to describe a topology in order to enable generic matching between physical devices connected to the network and the FDI® Server hosted Information Model.

A.2 Target Namespace

The target namespace defined for the scan result is defined by:

```
<xs:schema
   xmlns:PI="http://PI/2012/FDI/PROFILE/PROFINET"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
   targetNamespace="http://PI/2012/FDI/PROFILE/PROFINET"
   elementFormDefault="unqualified" version="1.1.0">
```

A.3 Network

The subsequent element is used to return the scan result corresponding to the Information Model described in IEC 62769-5.

The XML schema for a Network element is:

```
<xs:element name="Network" type="PI:ProfinetNetworkT"/>
```

A.4 ProfinetNetworkT

The XML schema for a ProfinetNetworkT type is:

```
<xs:complexType name="ProfinetNetworkT">
   <xs:sequence maxOccurs="unbounded">
      <xs:element name="ConnectionPoint"
         type="PI:ProfinetConnectionPointT"/>
   </xs:sequence>
</xs:complexType>
```

The elements of a ProfinetNetworkT type are described in Table A.1.

Table A.1 – Elements of ProfinetNetworkT

Element	Description
ConnectionPoint	The ConnectionPoint element holds the address and identification of the network connected device that has been found during bus scan operations.

A.5 ProfinetConnectionPointT

The XML schema for a ProfinetConnectionPointT type is:

```
<xs:complexType name="ProfinetConnectionPointT">
   <xs:sequence>
      <xs:element name="Identification"
         type="PI:ProfinetIdentificationT"/>
   </xs:sequence>
   <xs:attribute name="MAC" type="PI:MACT" use="required"/>
   <xs:attribute name="IPv4" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="DNSName" type="PI:DNSNameT" use="optional"/>
   <xs:attribute name="SubnetMask" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="Gateway" type="PI:IPv4T" use="optional"/>
</xs:complexType>
```

The attributes of a ProfinetConnectionPointT type are described in Table A.2.

Table A.2 – Attributes of ProfinetConnectionPointT

Attribute	Description
MAC	The attribute value holds the devices MAC address.
IPv4	The attribute value holds the IP/V4 address.
DNSname	The attribute holds the station name formatted after the "Domain Name System" (DNS).
SubnetMask	The attribute value holds the IP/V4 subnet mask.
Gateway	The attribute value holds the IP/V4 address of the gateway.

The elements of a ProfinetConnectionPointT type are described in Table A.3.

Table A.3 – Elements of ProfinetConnectionPointT

Element	Description
Identification	The Identification element holds the device type identification information of the network connected device that has been found during bus scan operations.

A.6 ProfinetIdentificationT

This type declaration corresponds partially to the "FunctionalGroup Identification".

The XML schema for a ProfinetIdentificationT type is:

```
<xs:complexType name="ProfinetIdentificationT">
   <xs:attribute name="VendorID" type="PI:Hex4DigitT" use="required"/>
   <xs:attribute name="DeviceID" type="PI:Hex4DigitT" use="required"/>
   <xs:attribute name="ORDER_ID" type="xs:string" use="optional"/>
   <xs:attribute name="SERIAL_NUMBER" type="xs:string"
      use="optional"/>
   <xs:attribute name="HARDWARE_REVISION" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="SOFTWARE_REVISION" type="xs:string"
      use="optional"/>
   <xs:attribute name="REV_COUNTER" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="PROFILE_ID" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="PROFILE_SPECIFIC_TYPE" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="IM_VERSION" type="xs:string" use="optional"/>
        <xs:attribute name="IM_SUPPORTED" type="xs:unsignedShort"
      use="optional"/>
   <xs:attribute name="DeviceType" type="xs:string" use="optional">
</xs:complexType>
```

The attributes of a ProfinetIdentificationT type are described in Table A.4.

Table A.4 – Attributes of ProfinetIdentificationT

Attribute	Description
VendorID	The attribute value contains the vendor specific part of the device identification number (DeviceIdentNumber) as defined in IEC 61158-5-10. The attribute corresponds to the GSDML defined attribute "VendorID".
DeviceID	The attribute value contains the device specific part of the device identification number (DeviceIdentNumber). The attribute corresponds to the GSDML defined attribute "DeviceID".
ORDER_ID	See Table 8
SERIAL_NUMBER	See Table 8
HARDWARE_REVISION	See Table 8
SOFTWARE_REVISION	See Table 8
REV_COUNTER	See Table 8
PROFILE_ID	See Table 8
PROFILE_SPECIFIC_TYPE	See Table 8
IM_VERSION	See Table 8
IM_SUPPORTED	See Table 8
DeviceType	See Table 8 DeviceType shall only be used, if FDI® Technology version of the FDI® Server and the FDI® Communications server is greater or equal to 1.3.0.

A.7 MACT

The XML schema for a MACT type is:

```
<xs:simpleType name="MACT">
   <xs:restriction base="xs:string">
      <xs:pattern value="([0-9a-fA-F][0-9a-fA-F]:){5}([0-9a-fA-F][0-
         9a-fA-F])"/>
   </xs:restriction>
</xs:simpleType>
```

A.8 IPv4T

The XML schema for an IPv4T type is:

```
<xs:simpleType name="IPv4T">
   <xs:restriction base="xs:string">
      <xs:pattern value="((25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-
         9])\.){3}(25[0-5]|2[0-4][0-9]|[01]?[0-9]?[0-9])"/>
   </xs:restriction>
</xs:simpleType>
```

A.9 IPv6T

The XML schema for an IPv6T type is:

```
<xs:simpleType name="IPv6T">
   <xs:restriction base="xs:string">
    <xs:pattern value="(([A-Fa-f0-9]{1,4}:){7}[A-Fa-f0-9]{1,4})"/>
   </xs:restriction>
</xs:simpleType>
```

A.10 DNSNameT

The XML schema for a DNSNameT type is:

```
<xs:simpleType name="DNSNameT">
   <xs:restriction base="xs:string">
      <xs:pattern value="[0-9a-zA-Z]([0-9a-zA-Z\-]{0,61}[0-9a-zA-
         Z])?(\.[0-9a-zA-Z]([0-9a-zA-Z\-]{0,61}[0-9a-zA-Z])?)*"/>
   </xs:restriction>
</xs:simpleType>
```

A.11 Hex4DigitT

The XML schema for a Hex4DigitT type is:

```
<xs:simpleType name="Hex4DigitT">
   <xs:restriction base="xs:string">
      <xs:pattern value="[0][x][0-9a-fA-F]{1,4}"/>
   </xs:restriction>
</xs:simpleType>
```

Annex B
(normative)

Transfer service parameters

B.1 General

Direct Access Services specified in IEC 62769-2 enable the User Interface Plug-in (UIP) to directly exchange data with the device. Direct data exchange means that data exchanged between a device and a UIP is not reflected in the Information Model. The IEC 62769-6 defined interface IDirectAccess corresponds to the IEC 62769-2 specified Direct Access Services. Interface IDirectAccess defined functions BeginTransfer and EndTransfer need to convey protocol specific information. The protocol specifics shall be captured in an XML document. The following specifies the XML document schema.

B.2 Target Namespace

The target namespace defined for the transfer service parameters document is defined in Clause A.2.

B.3 sendData

The element described in the following contains data to be submitted through the IDirectAccess function BeginTransfer defined argument sendData.

The XML schema for a sendData element is:

```
<xs:element name="sendData" type="PI:TransferSendDataT"/>
```

B.4 receiveData

The element described in the following contains data that is returned through the IDirectAccess function EndTransfer defined return value.

The XML schema for a receiveData element is:

```
<xs:element name="receiveData" type="PI:TransferResultDataT"/>
```

B.5 TransferSendDataT

A complex type that defines the service parameter data format that shall be applied to Transfer defined argument sendData.

The XML schema for a TransferSendDataT type is:

```
<xs:complexType name="TransferSendDataT">
   <xs:attribute name="OPERATION" type="PI:OperationT"
      use="required"/>
   <xs:attribute name="SLOT" type="xs:unsignedShort" use="required"/>
   <xs:attribute name="SUBSLOT" type="xs:unsignedShort"
      use="required"/>
   <xs:attribute name="INDEX" type="xs:unsignedShort" use="required"/>
   <xs:attribute name="API" type="xs:unsignedInt" use="required"/>
   <xs:attribute name="REQUEST" type="xs:hexBinary" use="required"/>
</xs:complexType>
```

The attributes of a TransferSendDataT type are described in Table B.1.

Table B.1 – Attributes of TransferSendDataT

Attribute	Description
OPERATION	The attribute corresponds to the Transfer method argument OPERATION.
SLOT	The attribute corresponds to the Transfer method argument SLOT.
SUBSLOT	The attribute corresponds to the Transfer method argument SUBSLOT.
INDEX	The attribute corresponds to the Transfer method argument INDEX.
API	The attribute corresponds to the Transfer method argument API.
REQUEST	The attribute corresponds to the Transfer method argument REQUEST.

B.6 TransferResultDataT

A complex type that defines the service parameter data format that shall be applied to Transfer defined receivedData return value.

The XML schema for a TransferResultDataT type is:

```
<xs:complexType name="TransferResultDataT">
   <xs:attribute name="REPLY" type="xs:hexBinary" use="required"/>
   <xs:attribute name="RESPONSE_CODES" type="xs:hexBinary"
      use="required"/>
</xs:complexType>
```

The attributes of a TransferResultDataT type are described in Table B.2.

Table B.2 – Attributes of TransferResultDataT

Attribute	Description
REPLY	The attribute corresponds to the Transfer method argument REPLY.
RESPONSE_CODES	The attribute corresponds to the Transfer method argument RESPONSE_CODES.

B.7 OperationT

A simple type that defines possible service operations.

The XML schema for an OperationT enumeration type is:

```
<xs:simpleType name="OperationT">
   <xs:restriction base="xs:string">
      <xs:enumeration value="READ"/>
      <xs:enumeration value="WRITE"/>
   </xs:restriction>
</xs:simpleType>
```

Annex C
(informative)

Mapping to PA DIM

C.1 General

FCG TS62769-8 specifies how the internal view of a device model represented by the EDD can be transferred into an external view as an OPC-UA information model by mapping EDD constructs to OPC-UA objects. This Annex C gives an overview on the mapping of standard parameters defined in PROFIBUS PA Profile 3.02 and PROFIBUS/PROFINET Profile 4.01 to PA DIM.

C.2 Mapping table

Table C.1 specifies the parameters, for which a direct mapping exists. Other parameters as for example the manufacturer cannot be mapped directly. In these cases mapping tables can be used.

Table C.1 – Mapping from PN standard parameters to PA DIM

Usage	PA-DIM BrowsePath	IEC 61987 CDD	Mapping PROFIBUS PA Profile 4.0
Identification	SerialNumber	0112/2///61987#ABA951#007	PB.IM_Serial_Number
Identification	HardwareRevision	0112/2///61987#ABA926#006	PB.HARDWARE_REVISION
Identification	SoftwareRevision	0112/2///61987#ABA601#006	PB.SOFTWARE_REVISION
Identification	RevisionCounter	0112/2///61987#ABN603#001	PB.IM_Revision_Counter
Identification	ProductCode	0112/2///61987#ABA300#006	PB.OrderID
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	IM_Tag_Location
DeviceHealth	DeviceHealth	0112/2///61987#ABN972#001	NE107_STATUS
Administration	DisplayLanguage	0112/2///61987#ABN597#001	PB.LANGUAGE
Administration	DateOfLastChange	0112/2///61987#ABN604#001	LATEST_CHANGE
Identification	RevisionCounter	0112/2///61987#ABN603#001	PB.IM_Revision_Counter
AssetId (User Tag of Device)	AssetId	0112/2///61987#ABA038#003	IM_Tag_Location

Bibliography

IEC 61804-3, *Devices and integration in enterprise systems – 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 62769 (all parts), *Field device integration (FDI®)*

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

ISO 15745-4:2003/AMD 1, *Industrial automation systems and integration – Open systems application integration framework – Part 4: Reference description for Ethernet-based control systems – Amendment 1: PROFINET profiles*

IEEE Std 802.3, *IEEE Standard for Ethernet*

PI Order No.: 2.352:2011, *GSDML Specification for PROFINET IO,* available at <www.PROFIBUS.com>

IETF RFC 791: *Internet Protocol*, available at <www.rfc-editor.org>

IETF RFC 1035: *Domain names – implementation and specification*, available at <www.rfc-editor.org>

IETF RFC 1123: *Requirements for Internet Hosts – Application and Support*, available at <www.rfc-editor.org>

IETF RFC 2181: *Clarifications to the DNS Specification*, available at www.rfc-editor.org

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI®) –

Partie 103-4: PROFINET

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Cette troisième édition annule et remplace la deuxième édition parue en 2020. Cette édition constitue une révision technique.

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

a) ajout de DeviceType à ProfinetIdentificationT;
b) ajout d'un espace de noms à l'Annexe A et à l'Annexe B;
c) ajout d'une règle de mapping pour le type d'appareil lors d'une exécution en mode profil;

d) remplacement du fichier GSD par le fichier GSDML, plus précis en ce qui concerne le mapping du type d'appareil;

e) ajout du mapping avec le PA DIM (Process Automation Device Information Model).

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

Projet	Rapport de vote
65E/863/CDV	65E/920/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

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

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI®) –

Partie 103-4: PROFINET

1 Domaine d'application

La présente partie de l'IEC 62769 spécifie un profil FDI®[1] de l'IEC 62769 pour les profils de communication CP 3/4, CP 3/5 et CP 3/6 (PROFINET[2]) définis dans l'IEC 61784-2.

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 61158-5-10, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 5-10: Définition des services de la couche application – Eléments de type 10*

IEC 61784-2, *Réseaux de communication industriels – Profils – Partie 2: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3*

IEC 61804 (toutes les parties), *Les dispositifs et leur intégration dans les systèmes de l'entreprise – Blocs fonctionnels (FB) pour les procédés industriels et le langage de description électronique de produit (EDDL)*

IEC 62541-100:2015, *Architecture unifiée OPC – Partie 100: Interface d'appareils*

IEC 62769-2, *Intégration des appareils de terrain (FDI®) – Partie 2: Client*

IEC 62769-4, *Intégration des appareils de terrain (FDI®) – Partie 4: Paquetages FDI®*

IEC 62769-5, *Intégration des appareils de terrain (FDI®) – Partie 5: Modèle d'information*

IEC 62769-6, *Intégration des appareils de terrain (FDI®) – Partie 6: Mapping de technologies*

IEC 62769-7, *Intégration des appareils de terrain (FDI®) – Partie 7: Appareils de communication*

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Spécification PI n° 2.122:2008, *Specification for PROFIBUS – Device Description and Device Integration – Volume 1: GSD, V5.1, juillet 2008: GSD,* disponible en anglais à l'adresse <www.PROFIBUS.com>

Spécification PI n° 2.352:2014, *GSDML Specification for PROFINET IO*, disponible en anglais à l'adresse <www.PROFIBUS.com>

3 Termes, définitions, abréviations et acronymes

3.1 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 61158-5-10, IEC 61784-2, l'IEC 61804 (toutes les parties), l'IEC 62541-100, l'IEC 62769-2, l'IEC 62769-4, l'IEC 62769-5, l'IEC 62769-6, l'IEC 62769-7 et la Spécification PI n° 2.352:2014 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

3.2 Abréviations et acronymes

Pour les besoins du présent document, les abréviations et acronymes suivants s'appliquent:

DCP (Discovery and Basic Configuration Protocol)	Protocole de découverte et de configuration de base (voir l'IEC 61158-5-10)
DNS (Domain Name System)	Système de noms de domaine
EDD (Electronic Device Description)	Description électronique de produit
EDDL (Electronic Device Description Language)	Langage de description électronique de produit (voir l'IEC 61804 (toutes les parties))
GSD (General Station Description)	Description générale de station (voir la Spécification PI n° 2.122:2008)
GSDML (GSD Extensible Markup Language)	Langage de balisage GSD (voir la Spécification PI n° 2.352:2014)
IP (Internet Protocol)	Protocole Internet (IETF RFC 791)
UIP (User Interface Plug-in)	Plugiciel d'interface utilisateur
UUID (Universally Unique Identifier)	Identificateur unique universel (voir l'ISO/IEC 11578)
XML (Extensible Markup Language)	Langage de balisage extensible (voir REC-xml-20081126)

4 Conventions

4.1 Syntaxe EDDL

Le présent document spécifie le contenu du composant EDD qui fait partie des Paquetages de communication FDI®. Le contenu de la spécification qui utilise la syntaxe EDDL est rédigé avec la police Courier New. La syntaxe EDDL est utilisée pour les déclarations de signature de méthode, de variable, de structure de données et de composant.

4.2 Syntaxe XML

Les exemples de syntaxe XML utilisent la police Courier New. La syntaxe XML est utilisée pour décrire le schéma des documents XML.

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

4.3 Utilisation de majuscules

La série IEC 62769 utilise des termes en majuscules pour souligner que ces termes ont une signification spécifique de la FDI®.

Certains de ces termes utilisent un acronyme comme préfixe, par exemple:

- Client FDI®; ou
- Serveur FDI®.

Certains de ces termes sont des termes composés, par exemple:

- Serveurs de communication; ou
- Paquetage de Profil.

Les noms de paramètres ou attributs sont concaténés en un seul et même terme, où les termes d'origine composant ce terme commencent par une lettre majuscule. Par exemple:

- ProtocolSupportFile; ou
- ProtocolType.

Les noms de paramètres ou attributs peuvent également être combinés au moyen d'un trait de soulignement afin de concaténer deux ou plusieurs termes. Par exemple:

- PROFILE_ID; ou
- Profinet_PA_Network.

5 Profil pour PROFINET

5.1 Généralités

Le présent document de profil, lié à la spécification FDI® de l'IEC 62769, spécifie les éléments spécifiques du protocole nécessaires aux Paquetages FDI® qui décrivent les Serveurs de communication, les Passerelles et les Appareils.

Pour les Serveurs de communication, le présent document définit également les éléments spécifiques du protocole qu'il est nécessaire de prendre en compte dans le Modèle d'information hébergé sur les Serveurs de communication.

L'Annexe B définit le schéma XML des Services d'accès direct. L'Annexe C fournit une vue d'ensemble du mapping des paramètres normalisés PROFIBUS avec le PA DIM.

5.2 Profil de catalogue

5.2.1 Fichier de prise en charge de protocole

5.2.1.1 Paquetage d'Appareil FDI®

Un fichier GSDML est une Pièce jointe obligatoire pour les Paquetages d'Appareils FDI® qui représentent des appareils PROFINET IO.

Les pièces jointes spécifiques à un protocole sont mentionnées dans le Catalogue de Paquetage, comme cela est défini dans l'IEC 62769-5. Un fichier de langage de balisage (GSDML), qui contient la liste des caractéristiques de communication (GSDML) conformément à la Spécification PI n° 2.352:2014, est une pièce jointe obligatoire pour les Paquetages d'Appareils FDI® qui représentent des appareils PROFINET. Le Tableau 1 spécifie les paramètres du ProtocolSupportFile dans le Paquetage d'Appareil FDI®.

Tableau 1 – ProtocolSupportFile pour les Paquetages d'appareils FDI®

Paramètre	Description
Type de contenu	texte/xml
Root Namespace (Espace de noms racine)	Vide
Relation source	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Nom de fichier	Conformément à la Spécification PI n° 2.352:2014

5.2.1.2 paquetage de communication FDI®

Un fichier GSDML, comme cela est spécifié dans l'ISO 15745-4:2003/AMD1, est une pièce jointe facultative pour les Paquetages de Communication FDI® qui représentent des appareils PROFINET IO. Le Tableau 2 spécifie les paramètres de ProtocolSupportFile pour les Paquetages de communication FDI®.

Tableau 2 – ProtocolSupportFile pour les Paquetages de communication FDI®

Paramètre	Description
Type de contenu	texte/xml
Root Namespace (Espace de noms racine)	Vide
Relation source	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Nom de fichier	Conformément à la Spécification PI n° 2.352:2014

5.2.2 Définition du CommunicationProfile

L'IEC 62769-4 définit une chaîne CommunicationProfileT pour le schéma XML Catalog. La valeur spécifique de PROFINET doit être "profinet_io".

5.2.3 Appareil de profil

Un Paquetage de Profil doit fournir les valeurs de catalogue des appareils de profil en permettant au Serveur FDI® d'optimiser la description d'appareil générique, si une description spécifique n'est pas disponible. Les définitions du Tableau 3 portent sur le contenu du catalogue qui est indépendant du fournisseur.

Tableau 3 – Valeurs de catalogue pour les appareils de profil

Elément	Attribut	Contenu
PackageType	—	Profil
Manufacturer	—	Vide
DeviceModel	—	Les valeurs d'identificateur de profil admises (PROFILE_ID) sont fournies par PROFIBUS & PROFINET International (PI). PI fournit et gère un fichier XML (Profile_ID_Table) qui contient l'attribution des PROFILE_ID aux profils. Il est disponible à l'adresse <http://www.profibus.com/IM/Profile_ID_Table.xml>. Le fichier peut être téléchargé par n'importe quel outil technique ou outil de service, dès lors qu'il est connecté à Internet. NOTE Des informations supplémentaires sont fournies dans la spécification PI n° 3.502 (Profil I&M) et les définitions de profils connexes référencées. La chaîne doit être au format hexadécimal en commençant par 0x, par exemple "0x3D00".

5.2.4 Informations relatives à la version du protocole

L'IEC 62769-4 définit un type d'élément nommé InterfaceT pour le schéma XML Catalog. Le type d'élément InterfaceT contient un élément nommé Version qui a pour objet de fournir des informations de version relatives au profil de protocole de communication appliqué. La valeur doit respecter le schéma d'informations de version de l'IEC 62769-4 défini dans le type d'élément VersionT. Le Tableau 4 décrit comment appliquer les versions de protocole actuellement connues qui sont définies par le consortium à but non lucratif PROFIBUS & PROFINET International. La règle générale consiste à utiliser la valeur "0" pour les parties des informations de version, établies conformément à l'IEC 62769-4, qui ne sont pas utilisées par des versions de protocole actuellement connues.

Tableau 4 – Exemples de mapping de versions

Protocole/version	Valeur de version InterfaceT
PROFINET version 2.3	2.3.0
NOTE 1 Ce tableau est seulement un exemple, car le présent document ne peut pas prévoir comment les futures versions de protocole seront définies. NOTE 2 Les informations de révision de protocole PROFINET actuellement connues fournissent les informations relatives aux versions majeure et mineure. Les zéros de tête ne sont pas pris en compte dans l'évaluation de la valeur des versions, car seules les valeurs décimales réelles sont pertinentes.	

5.3 Association d'un Paquetage à un appareil

5.3.1 Mapping d'identification du type d'appareil

L'objet du mapping d'identification du type d'appareil est de configurer les systèmes Hôtes FDI® afin qu'ils comparent le résultat du balayage à la représentation topologique dans le Modèle d'information. Les systèmes Hôtes FDI® doivent également être configurés afin de déterminer le Paquetage d'Appareil FDI® qui convient pour une entrée d'appareil contenue dans le résultat du balayage. Cela permet à l'utilisateur d'un système Hôte FDI® de synchroniser le Modèle d'information avec l'installation réelle.

Le service de balayage mis en œuvre dans le serveur de communication (défini au 5.6.1.7) fournit un résultat de balayage par l'intermédiaire d'un document XML (schéma défini à l'Annexe A).

Le service de balayage mis en œuvre par la Passerelle (défini en 5.6.2.7) fournit un résultat de balayage au moyen du Modèle d'information qui contient des structures de données créées à partir du contenu EDD, comme cela est spécifié en 5.6.2.7.

Les deux manières de présenter le résultat du balayage ont en commun le fait que les résultats du balayage contiennent une identification du type d'appareil et une identification de l'instance d'appareil.

Les systèmes Hôtes FDI®, qui comparent la configuration de la topologie réseau réelle à la représentation topologique du Modèle d'information, doivent être en mesure de gérer les situations suivantes:

a) l'instance d'Appareil physique identifiée à une adresse d'appareil spécifique n'est pas logiquement présente dans le Modèle d'information (en tant qu'Instance): configurer le système Hôte FDI® afin qu'il trouve le Paquetage d'Appareil FDI® approprié en fonction des informations du catalogue d'appareils;

b) l'instance d'Appareil physique identifiée par l'adresse de l'appareil est logiquement présente dans le Modèle d'information (en tant qu'Instance): configurer le système Hôte FDI® afin qu'il compare les informations de type d'appareil fournies dans le résultat du balayage (voir l'identification à l'Article A.6 et en 5.6.2.7) aux informations spécifiques du type d'appareil de l'Instance fournies dans le Modèle d'information.

Le Paquetage d'Appareil FDI® contient des informations d'identification de type d'appareil qui peuvent être comparées au résultat du balayage issu du schéma Catalog de l'IEC 62769-4, qui définit les types d'éléments XML (simples) "DeviceModel" et "Manufacturer". Ces deux types sont utilisés dans les types d'éléments (complexes) "Protocol" et "RegDeviceType".

Après le déploiement du Paquetage FDI®, les informations relatives au Paquetage FDI® sont alors présentes dans le Modèle d'information sous la forme du FunctionalGroup "Identification" spécifié, qui contient VendorID et DeviceID (voir 5.4.3).

Si un appareil est utilisé comme un appareil de profil, le DeviceID renvoyé dans le résultat du balayage ne correspond pas au DeviceID dans la GSDML. Dans ce cas, le DeviceType peut être utilisé pour identifier le Paquetage FDI® en fonction du nom de l'appareil dans le Catalogue de Paquetage FDI®.

Le mapping entre les différentes sources de données d'identification d'appareil est décrit dans le Tableau 5. Etant donné que les résultats du balayage fournis par le Serveur de communication ou la Passerelle peuvent comporter des données produites par l'appareil (micrologiciel), le mapping d'identification de type d'appareil doit être assuré en fournissant les données correspondantes qui figurent dans le Catalogue et le Modèle d'information du Paquetage d'Appareil FDI®.

Tableau 5 – Mapping des informations d'identification d'appareil

Paquetage d'Appareil FDI®	Modèle d'information	Résultat du balayage fourni par le Serveur de Communication	Résultat du balayage fourni par la Passerelle
Type spécifié dans le catalogue Manufacturer	FunctionalGroup: Identification Nom d'exploration: VendorID	Elément (chemin): ConnectionPoint/Identification Attribut: VendorID	COLLECTION ConnectionPoint. Identification.VendorID
Type spécifié dans le catalogue DeviceModel	FunctionalGroup: Identification Nom d'exploration: DeviceID	Elément (chemin): ConnectionPoint/Identification Attribut: DeviceID	COLLECTION ConnectionPoint. Identification.DeviceID

5.3.2 Mapping de révision de type d'appareil

L'IEC 62769-4 prévoit un concept qui permet de déterminer la compatibilité entre un Paquetage d'Appareil FDI® et un Appareil. L'IEC 62769-4 spécifie un processus de gestion du cycle de vie qui s'appuie sur une information de version unique fournie pour l'ensemble de l'appareil.

Les spécifications PROFINET IO, par exemple les spécifications PI n° 2.352:2011 (GSDML) et n° 3.502 (I&M), divisent la révision d'appareil en informations relatives au logiciel et en informations relatives au matériel. Ces spécifications ne soulignent aucune règle qui permettent de savoir si HARDWARE_REVISION, spécifié en GSD, GSDML ou I&M, est indépendant de SOFTWARE_REVISION.

L'objectif de 5.3.2 est de décrire les règles de traduction entre les spécifications PROFINET IO, en décrivant comment sont fournies les informations de version, ainsi que la méthode spécifiée par l'IEC 62769-4 pour les informations de version qui peuvent être comparées à la version lue dans l'appareil. L'objectif est de déterminer la compatibilité entre un Paquetage d'Appareil FDI® et un Appareil (la Figure 1 décrit le problème).

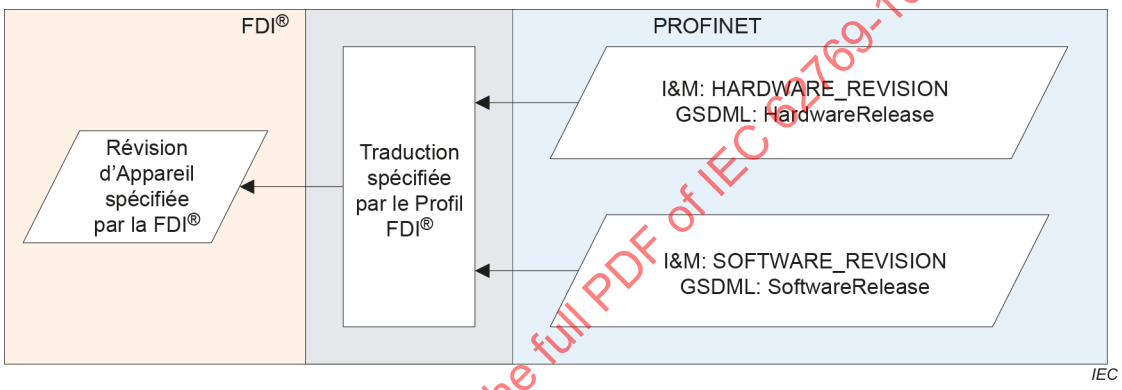

Figure 1 – Problème de mapping des versions

Le micrologiciel d'un appareil met en œuvre l'interface d'échange de données qui doit être décrite au moyen du contenu du Paquetage d'Appareil FDI® (EDD). Un micrologiciel d'appareil qui met en œuvre le profil GSD, GSDML ou I&M permet de lire les valeurs SOFTWARE_REVISION et HARDWARE_REVISION. L'accès à ces valeurs doit être décrit dans l'EDD contenue dans le Paquetage d'Appareil FDI®.

Les modifications du micrologiciel qui ont une incidence sur l'interface d'échange de données mise en œuvre par le micrologiciel doivent être reflétées dans le Paquetage d'Appareil FDI®. De telles modifications de micrologiciel et de description d'appareil doivent être visibles dans l'attribut SOFTWARE_REVISION.

Les modifications relatives au matériel doivent être collectées dans l'attribut HARDWARE_REVISION. Les modifications du matériel n'exigent pas toujours une mise à jour du micrologiciel. Par conséquent, HARDWARE_REVISION ne peut pas être utilisé pour déterminer la compatibilité entre un appareil et le Paquetage d'Appareil FDI®. Par contre, si une modification du matériel exige des modifications du micrologiciel, HARDWARE_REVISION et SOFTWARE_REVISION doivent être modifiés tous les deux.

L'IEC 62769-4 spécifie le schéma Catalog et un élément DeviceVersion qui est utilisé dans la déclaration de type d'élément ListOfSupportedDeviceVersions. La valeur de DeviceVersion doit être comparée à l'attribut SOFTWARE_REVISION fourni par l'appareil afin de déterminer la compatibilité entre un Paquetage d'Appareil FDI® et un Appareil.

Le format de données pour l'attribut SOFTWARE_REVISION est une chaîne alors que l'élément DeviceVersion attend trois chiffres (version majeure, version mineure et révision). Par

conséquent, les règles suivantes s'appliquent: si la chaîne est au format <entier>.<entier>.<entier>, elle est transférée ainsi: majeure, mineure et révision (dans le même ordre). <entier> désigne un nombre entier simple dans la chaîne, par exemple "1" ou "12", mais aucune autre représentation telle que le format hexadécimal (par exemple "0x001A"). Si la chaîne est au format <entier>.<entier>, elle est transférée ainsi: majeure, mineure et "0" est utilisé pour la révision. Si la chaîne comporte un seul <entier>, elle est transférée ainsi: majeure et "0" est utilisé pour mineure et la révision. Un caractère de poids fort ou un caractère de poids fort associé à un espace doivent être ignorés. Si une chaîne figure dans un autre format, le numéro de révision ne doit pas être pris en compte pour choisir le Paquetage FDI® adéquat.

5.4 Mapping du Modèle d'information

5.4.1 Définition du ProtocolType

La présente norme traite des protocoles spécifiés par l'IEC 61158, car ils sont appropriés pour prendre en charge les cas d'utilisation relatifs à la gestion d'appareils qui sont pris en charge par les spécifications FDI®. Le domaine d'application est limité au transport de données du Modèle d'information vers l'appareil.

Par exemple, la gestion des adresses d'appareils repose sur les services spécifiés dans la série IEC 61158. Mais, étant donné que le service de gestion d'adresses est encapsulé par le service SetAddress spécifié par l'IEC 62769-7, les informations des services spécifiés par l'IEC 61158 peuvent ne pas être connues.

Le type de protocole Profinet_IO doit être utilisé pour identifier la communication PROFINET IO. Le type Profinet_IO est un sous-type du type abstrait ProtocolType (IEC 62541-100). Le Tableau 6 spécifie les attributs et les valeurs du type de protocole Profinet_IO.

Tableau 6 – Type de protocole Profinet_IO

Attribut	**Valeur**				
BrowseName	Profinet_IO				
IsAbstract	False				
Références	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Sous-type du ProtocolType défini dans l'IEC 62541-100.					

5.4.2 Mapping de DeviceType

Le mapping des propriétés du nœud DeviceType est défini dans le Tableau 7.

Tableau 7 – Mapping des propriétés DeviceType

Propriété	Mapping PROFINET
SerialNumber	SERIAL_NUMBER (voir Tableau 8)
RevisionCounter	REV_COUNTER (voir Tableau 8)
Manufacturer	Chaîne issue du Catalogue de Paquetage FDI® (ManufacturerName issu de PackageT)
Model	Chaîne issue du Catalogue de Paquetage FDI® (Name de DeviceTypeT, qui est un nom localisé)
DeviceRevision	Non prise en charge
DeviceManual	Non prise en charge
SoftwareRevision	SOFTWARE_REVISION (voir Tableau 8)
HardwareRevision	HARDWARE_REVISION (voir Tableau 8)

5.4.3 Définition du FunctionalGroup "Identification"

Comme cela est défini en 5.3 de l'IEC 62541-100:2015, chaque représentation d'appareil dans le Modèle d'information hébergé sur le Serveur FDI® doit contenir un FunctionalGroup spécifique d'un protocole, appelé Identification. Les paramètres de ce FunctionalGroup sont définis pour les profils PROFINET comme suit:

Tableau 8 – Définition du type d'identification PROFINET

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

Les instances de BaseDataVariable doivent être créées à partir des déclarations de VARIABLE avec des identificateurs qui correspondent aux noms d'exploration énumérés dans le Tableau 8, à l'exception des attributs VendorID et DeviceID. Les valeurs d'attributs connexes doivent être issues du fichier GSD (5.2.1). Les noms d'éléments VendorID et DeviceID concordent avec les noms d'attributs définis dans la spécification GSDML.

5.5 Eléments de topologie

5.5.1 Définition du ConnectionPoint

Afin de prendre en charge les différents besoins d'ingénierie de topologie réseau relatifs aux différentes couches de protocoles utilisées pour PROFINET IO, la définition des types de ConnectionPoints respecte les recommandations données dans l'IEC 62769-7 en ce qui concerne la manière de traiter les informations d'adresse pour les couches de protocoles imbriquées dans PROFINET IO.

Le ConnectionPoint de type ConnectionPoint_Profinet_IO doit être utilisé pour paramétrer les points d'accès réseau PROFINET IO. Le ConnectionPoint de type Profinet_IO est un sous-type du type abstrait ConnectionPointType (IEC 62769-5). Le Tableau 9 spécifie les valeurs admises des attributs ConnectionPoint pour le type de protocole Profinet_IO.

Tableau 9 – Type de ConnectionPoint pour Profinet_IO

Attribut	**Valeur**				
BrowseName	Profinet_IO				
IsAbstract	False				
Références	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Sous-type du ConnectionPointType défini dans l'IEC 62541-100.					
HasProperty	Variable	MAC	Octet[6]	PropertyType	Obligatoire
HasProperty	Variable	IPv4	Octet[4]	PropertyType	Obligatoire
HasProperty	Variable	DNSNAME	String	PropertyType	Obligatoire
HasProperty	Variable	VALID	Boolean	PropertyType	Obligatoire

Le ConnectionPoint de type Profinet_IO doit être décrit par un élément EDD contenu dans le Paquetage FDI® associé à un Appareil de communication, qui peut piloter un réseau PROFIBUS IO. Les propriétés réelles de ConnectionPoint sont déclarées par des constructions VARIABLE regroupées dans une COLLECTION nommée ConnectionPoint.

La variable MAC est une matrice de 6 octets qui contient l'adresse MAC. La valeur est un identificateur unique attribué à des interfaces réseau qui prennent en charge la communication spécifiée par la norme IEEE 802.3. La valeur peut uniquement être lue dans l'appareil, par exemple pendant l'exécution du service de balayage.

La variable IPv4 est une matrice de 4 octets qui contient l'adresse IP.

NOTE 1 Le formatage d'une adresse IP donne généralement une chaîne de caractères composée de quatre nombres décimaux de 1 à 3 chiffres, séparés par le caractère "." (exemple: 128.12.1.15). La spécification de l'EDDL selon l'IEC 61804-3 et l'IEC 61804-4 ne prend pas en charge les instructions de formatage pour le type OCTET. Mais, étant donné que la sémantique des définitions de VARIABLE données dans la présente partie de l'IEC 62769 est définie, il est pris pour hypothèse que le système peut rendre les valeurs de VARIABLE en conséquence.

La variable DNSNAME contient le nom de station. La syntaxe du nom de station doit suivre les spécifications relatives au système de noms de domaine (DNS).

NOTE 2 Le système de noms de domaine (DNS) est un système de dénomination hiérarchique qui traduit les noms de domaine dont la syntaxe est intelligible pour l'homme en identificateurs numériques associés au matériel de réseautage dans l'objectif de localiser et d'adresser ces appareils. Les spécifications des règles de formation des noms de domaine sont disponibles dans la IETF RFC 1035, la IETF RFC 1123 et la IETF RFC 2181.

La variable Valid indique si les informations d'adresse stockées sont valides.

```
COMPONENT ConnectionPoint_PROFINET_IO
{
  LABEL "PROFINET IO Connection point";
  CAN_DELETE FALSE;
  PROTOCOL PROFINET;
}

VARIABLE MAC
{
  LABEL "MAC address";
  HELP "Unique network visible device identifier";
  CLASS DEVICE;
  TYPE OCTET(6);
  HANDLING READ;
  CLASS LOCAL;
}

VARIABLE IPv4
{
  LABEL "IP Address";
  HELP "IP v4 address";
  CLASS DEVICE;
  TYPE OCTET(4);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

VARIABLE DNS_Name
{
  LABEL "DNS Name";
  HELP "Station name";
  CLASS DEVICE;
  TYPE BITSTRING(256);
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

COLLECTION ConnectionPoint
{
  LABEL "PROFINET Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_MAC, MAC;
    CONNECTION_POINT_IPV4, IPv4;
    CONNECTION_POINT_DNS_NAME, DNS_Name;
  }
}
```


5.5.2 Définition de l'appareil de communication

Conformément à l'IEC 62769-7, chaque Paquetage de communication FDI® doit contenir un élément EDD qui décrit l'appareil. Le code source EDDL ci-après est un exemple qui décrit un Serveur de communication.