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INTERNATIONAL STANDARD

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Field device integration (FDI) –
Part 103-1: Profiles – PROFIBUS

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IEC 62769-103-1

INTERNATIONAL STANDARD

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**Field device integration (FDI) –
Part 103-1: Profiles – PROFIBUS**

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FIELD DEVICE INTEGRATION (FDI) –

Part 103-1: Profiles – PROFIBUS

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. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62769-103-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

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

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

a) support for generic protocol extension for faster adoption of other technologies;
b) support for Package Developers to build EDDs targeted for today's EDD bases system under a single development tool.

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

CDV	Report on voting
65E/622/CDV	65E/685A/RVC 65E/685/RVC

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

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

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

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

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- withdrawn,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

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INTRODUCTION

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

a) method for the supplying and installation of device-specific functionalities, see Patent Family DE10357276;

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

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

d) extensible device object model, see Patent Family US12/893,680.

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FIELD DEVICE INTEGRATION (FDI) –

Part 103-1: Profiles – PROFIBUS

1 Scope

This part of IEC 62769 specifies an FDI profile of IEC 62769 for IEC 61784-1_CP 3/1 (PROFIBUS DP)[1] and IEC 61784-1_CP3/2 (PROFIBUS PA)[1].

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 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 61804 (all parts), *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[2], *Field Device Integration (FDI) - Part 2: FDI Client*

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

IEC 62769-4[3], *Field Device Integration (FDI) – Part 4: FDI Packages*

NOTE 2   IEC 62769-4 is technically identical to FDI-2024.

IEC 62769-5[4], *Field Device Integration (FDI) – Part 5: FDI Information Model*

NOTE 3   IEC 62769-5 is technically identical to FDI-2025.

IEC 62769-7[5], *Field Device Integration (FDI) – Part 7: FDI Communication Devices*

NOTE 4   IEC 62769-7 is technically identical to FDI-2027.

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> [viewed 2018-11-23]

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1   PROFIBUS is the trade name of the non-profit consortium PROFIBUS & PROFINET International. 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.

2   Under preparation. Stage at the time of publication: IEC/RFDIS 62769-2:2020.

3   Under preparation. Stage at the time of publication: IEC/RFDIS 62769-4:2020.

4   Under preparation. Stage at the time of publication: IEC/RFDIS 62769-5:2020.

5   Under preparation. Stage at the time of publication: IEC/RFDIS 62769-7:2020.

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

3.1   Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-1, IEC 61804 (all parts), IEC 62541-100, IEC 62769-4, IEC 62769-5, IEC 62769-7 and PI Order No.: 2.122:2008 apply.

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

• IEC Electropedia: available at http://www.electropedia.org/

• ISO Online browsing platform: available at http://www.iso.org/obp

3.2   Abbreviated terms and acronyms

For the purposes of this document, the following abbreviations apply:

EDD   Electronic Device Description

EDDL   Electronic Device Description Language (see IEC 61804)

GSD   General station description (see PI Order No.: 2.122:2008)

I&M   Identification and maintenance function

~~UIP   User Interface Plug-in~~

UUID   Universally unique identifier (see ISO/IEC 11578)

XML   Extensible markup language (see REC-xml-20081126)

3.3   Conventions

3.3.1   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.

3.3.2   XML syntax

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

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

3.3.3   Capitalizations

IEC 62769 (all parts) use capitalized terms to emphasize that these terms have a 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 Package.

Parameter names or attributes are concatenated to a single term, where the original terms start 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
- Profibus_PA_Network.

4   Profile for PROFIBUS

4.1   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.

4.2   Catalog profile

4.2.1   Protocol support file

4.2.1.1   FDI Device Package

Protocol specific attachments are mentioned in the Package Catalog as defined in IEC 62769-5. A communication feature list (GSD) file according to PI Order No.: 2.122:2008 is a mandatory attachment for FDI Device Packages representing PROFIBUS DP and PROFIBUS PA devices. Table 1 specifies the parameters of the ProtocolSupportFile in the FDI Device Package.

Table 1 – ProtocolSupportFile for FDI Device Packages

Parameter	Description
Content Type	text/plain
Root Namespace	empty
Source Relationship	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename	According to PI Order No.: 2.122:2008

4.2.1.2   FDI Communication Packages

A GSD file as specified in PI Order No.: 2.122:2008 is an optional attachment for FDI Communication Packages representing PROFIBUS DP and PROFIBUS PA devices. Table 2 specifies the parameters of ProtocolSupportFile for FDI Communication Packages.

Table 2 – ProtocolSupportFile for FDI Communication Packages

Parameter	Description
Content Type:	text/plain
Root Namespace:	empty
Source Relationship:	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename:	According to PI Order No.: 2.122:2008

4.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT ~~enumeration type~~ string for the Catalog XML schema. Table 3 defines the PROFIBUS specific values for this ~~enumeration~~ string.

Table 3 – PROFIBUS CommunicationProfile definition schema

Profile Identifier	Protocol
"profibus_dp"	PROFIBUS DP/V0; PROFIBUS DP/V1; PROFIBUS DP/V2
"profibus_pa"	PROFIBUS PA

4.2.3 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 4 focus on catalog content that is vendor independent.

Table 4 – Catalog values for profile devices

Element	Attribute	Content
PackageType	—	Profile
~~CommunicationProfile~~ Manufacturer	—	Empty
DeviceModel	—	The allowed profile identifier values (PROFILE_ID) are provided by PROFIBUS & PROFINET International (PI). PI provides and maintains an 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 is connected to the Internet. NOTE More information is provided in PI Order No.: 3.502 (I&M Profile) and related profile definitions are referred therein. The string format shall be hexadecimal starting with 0x, e.g. '0x3D00'.

4.2.4 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 5 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 5 – Version mapping examples[6]

Protocol / Version	InterfaceT Version value
PROFIBUS DP/V0	0.0.0[a]
PROFIBUS DP/V1	1.0.0[a]
PROFIBUS DP/V2	2.0.0[a]
PROFIBUS PA 3.02	3.2.0[b]
[a] The protocols PROFIBUS DP/V0, PROFIBUS DP/V1 and PROFIBUS DP/V2 contain a single number. This number is considered to be the major version. The minor and built numbers are set to "0".	
[b] The currently known PROFIBUS PA profile number is considered to provide major and minor version information. Leading zeros are not considered in version value evaluation since only the actual decimal values are relevant.	

4.3 Associating a Package with a device

4.3.1 Device type identification mapping

The purpose of 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 4.6.1.7) provides the scan result through an XML document (the schema is defined in Clause A.5).

The Gateway implemented scan service (defined in 4.6.2.7) provides the scan result by means of the Information Model that contains data structures created from EDD content as specified in 4.6.2.7.

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 catalog 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 device type information presented in scan result (see the identification in Clause A.5) 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 scan result based on the Catalog Schema in IEC 62769-4 defining the XML (simple) element types "DeviceModel" and "Manufacturer". Both types are used in the (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 the specified FunctionalGroup Identification containing Ident_Number and Manufacturer_ID (see 4.4.3). The Ident_Number matches with the GSD specified Ident_Number. Manufacturer_ID is specified through the I&M profile defined VendorID and DeviceID (see 4.4.3).

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[6] The given table can be considered to be an example only since this document cannot foresee how future protocol versions will be defined.

The mapping between different device identification data sources is described in Table 6. 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.

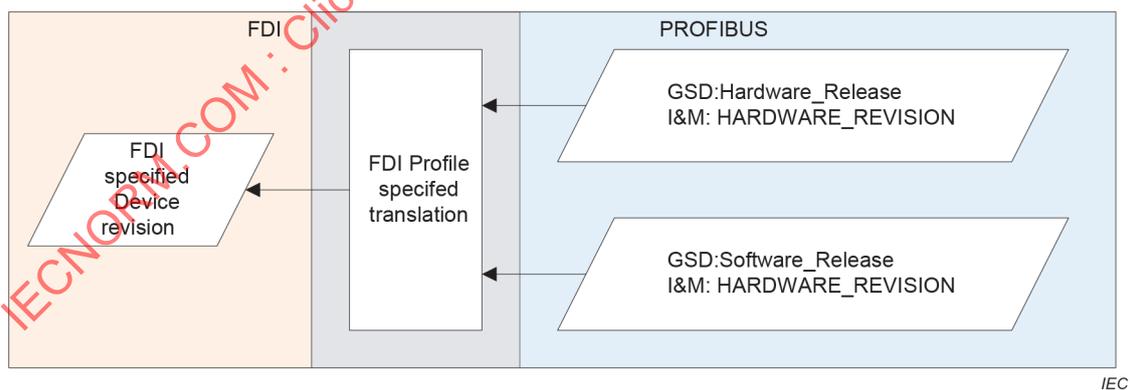**Table 6 – Device identification information mapping**

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

4.3.2   Device type revision mapping

IEC 62769-4 envisions a concept that allows to determine 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.

NOTE PROFIBUS related specifications, for example PI Order No.: 2.122:2008 (GSD) and PI Order No.: 3.502:2009 (I&M) splits the device type revision into software and hardware related information. The GSD specifies the attributes Hardware_Release and Software_Release. The I&M specifies HARDWARE_REVISION and SOFTWARE_REVISION. Hardware_Release and HARDWARE_REVISION ~~must~~ will always match. Software_Release and SOFTWARE_REVISION ~~must~~ will always match.

The goal of 4.3.2 is to describe the translation rules between PROFIBUS related specifications, describing their way of providing the version information, and the IEC 62769-4 specified way of containing the version information that can be compared against the version read from the device. The purpose is to determine the 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 PROFIBUS PA profile enables the reading of the values SOFTWARE_REVISION and HARDWARE_REVISION. The access to these values shall be described in the EDD contained in the FDI Device Package.

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 and Software_Release.

Hardware related modifications shall be captured in the HARDWARE_REVISION and Hardware_Release. Hardware related modifications do not necessarily always require a firmware update. Thus HARDWARE_REVISION and Hardware_Release 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. Hardware_Release and Software_Release shall be changed accordingly.

The IEC 62769-4 specifies the Catalog schema and an element DeviceVersion which is used in the element type declaration ListOfSupportedDeviceVersions. The value of the DeviceVersion shall be compared to the device provided SOFTWARE_REVISION or the GSD provided Software_Release 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.

4.4 Information Model mapping

4.4.1 ProtocolType definition

The concept to derive PROFIBUS DP and PROFIBUS PA specific Network Types applies to the protocol type definition.

The protocol type Profibus_DP shall be used to identify the PROFIBUS DP communication. The type Profibus_DP is a sub type of the abstract type ProtocolType in IEC 62541-100. Table 7 specifies the allowed values of the ProtocolType attributes for the protocol type Profibus_DP.

Table 7 – Protocol type Profibus_DP

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

The network type Profibus_PA_Network shall be used to build PROFIBUS PA network topologies. The type Profibus_DP_Network is a sub type of the abstract type NetworkType in IEC 62541-100. Table 8 specifies the allowed values of the ProtocolType attributes for the protocol type Profibus_PA.

Table 8 – Protocol type Profibus_PA

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

4.4.2   DeviceType mapping

The DeviceType property mapping of the DeviceType node is defined in Table 9.

Table 9 – DeviceType property mapping

Property	PROFIBUS Mapping
SerialNumber	SERIAL_NUMBER (see Table 10)
RevisionCounter	REV_COUNTER (see Table 10)
Manufacturer	~~MANUFACTURER_ID (see Table 10)~~ String taken from FDI package catalog (ManufacturerName from PackageT)
Model	~~ORDER_ID (see Table 10)~~ 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 10)
HardwareRevision	HARDWARE_REVISION (see Table 10)

4.4.3   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 PROFIBUS devices types as follows:

Table 10 – PROFIBUS Device Types identification attributes

BrowseName	DataType	Mandatory/Optional
Ident_Number	UInt16	Mandatory
MANUFACTURER_ID	UInt16	Mandatory
ORDER_ID	String	Optional
SERIAL_NUMBER	String	Optional
HARDWARE_REVISION	UInt16	Optional
SOFTWARE_REVISION	String	Optional
REV_COUNTER	UInt16	Optional
PROFILE_ID	UInt16	Optional
PROFILE_SPECIFIC_TYPE	UInt16	Optional
IM_VERSION	ByteString	Optional
IM_SUPPORTED	UInt16	Optional

The BaseDataVariable instances, except Ident_Number, shall be created from VARIABLE declarations with identifiers that correspond to the browse names listed in Table 10. The BaseDataVariable instances Ident_Number shall be created from the GSD file attribute Ident_Number.

4.5 Topology elements

4.5.1 ConnectionPoint definition

In order to support different network topology engineering needs related to different physical layers used by PROFIBUS DP and PROFIBUS PA, two different ConnectionPoint types shall be defined.

The ConnectionPoint type Profibus_DP shall be used to parameterize PROFIBUS DP network access points. The ConnectionPoint type Profibus_DP is a sub type of the abstract type ConnectionPointType defined in IEC 62541-100. Table 11 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profibus_DP.

Table 11 – ConnectionPoint type for Profibus_DP

Attribute	Value				
BrowseName	ConnectionPoint_Profibus_DP				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Sub type of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	Address	Byte	PropertyType	Mandatory

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

```
COMPONENT ConnectionPoint_Profibus_DP
{
  LABEL "PROFIBUS DP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL PROFIBUS_DP;
  CONNECTION_POINT ConnectionPoint;
}

VARIABLE Address
{
  LABEL "Station address";
  HELP "Address of the PROFIBUS slave";
  TYPE UNSIGNED_INTEGER(1)
  {
    INITIAL_VALUE 126;
    MIN_VALUE 0;
    MAX_VALUE 126;
  }
  HANDLING READ & WRITE;
  CLASS LOCAL;
}
```

```
COLLECTION ConnectionPoint
{
  LABEL "PROFIBUS DP Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_ADDRESS, Address;
  }
}
```

The ConnectionPoint type Profibus_PA shall be used to parameterize PROFIBUS PA network access points. The ConnectionPoint type Profibus_PA is a sub type of the abstract type ConnectionPointType defined in IEC 62541-100. Table 12 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profibus_PA.

Table 12 – ConnectionPoint type for Profibus_PA

Attribute	Value				
BrowseName	ConnectionPoint_Profibus_PA				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Subtype of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	Address	Byte	PropertyType	Mandatory

The Property Address allowed values are 0..126.

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

```
COMPONENT ConnectionPoint_Profibus_PA
{
  LABEL "PROFIBUS PA Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL PROFIBUS_PA;
}

VARIABLE Address
{
  LABEL "Station address";
  HELP "Address of the PROFIBUS slave";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(1)
  {
    INITIAL_VALUE 126;
    MIN_VALUE 0;
    MAX_VALUE 126;
  }
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

COLLECTION ConnectionPoint
{
  LABEL "PROFIBUS PA Connection Point data";
  MEMBERS
```

```
  {
    CONNECTION_POINT_ADDRESS, Address;
  }
}
```

4.5.2   Communication Device definition

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

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

COMPONENT_RELATION Profibus_Communication_Device_Setup
{
   LABEL "Relation between Device and communication device";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
      Profibus_Communication_Device{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 4;
}
```

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 in is an example for a PROFIBUS DP communication device:

```
COMPONENT Profibus_Communication_Device
{
  LABEL "PROFIBUS communication device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { Profibus_Service_Provider_Relation }
  BYTE_ORDER BIG_ENDIAN;
}

COMPONENT_RELATION Profibus_Service_Provider_Relation
{
   LABEL "Relation to communication service provider";
   RELATION_TYPE CHILD_COMPONENT;
   COMPONENTS
   {
      Profibus_Service_Provider{AUTO_CREATE 1;}
   }
   MINIMUM_NUMBER 1;
   MAXIMUM_NUMBER 1;
}
```

In an actual communication device the value "ConnectionPoint_Profibus_DP" needs to be adapted according to the supported protocol and the related connection point definitions given in 4.5. The attribute BYTE_ORDER value is to be set according to the protocol.

4.5.3   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 below is an example for a PROFINET IO communication service provider component:

The component reference (ConnectionPoint_Profibus_DP) corresponds to the related connection point definition in 4.5. The attribute BYTE_ORDER value is to be set according to the protocol.

```
COMPONENT Profibus_Service_Provider
{
  LABEL "PROFIBUS communication service provider";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS
  {
    Profibus_Service_Provider_Connection_Point_Relation
  }
  BYTE_ORDER BIG_ENDIAN; // EDDL extension
}

COMPONENT_RELATION Profibus_Service_Provider_Connection_Point_Relation
{
  LABEL "Relation between communication service provider and Connection Point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {Address}
  COMPONENTS
  {
    ConnectionPoint_Profibus_DP{ AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}
```

4.5.4   Network definition

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

```
COMPONENT Network_Profibus_DP
{
  LABEL "PROFIBUS DP Network";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK;
  COMPONENT_RELATIONS
  {
    Profibus_DP_Network_Connection_Point_Relation
  }
}

COMPONENT_RELATION Profibus_DP_Network_Connection_Point_Relation
{
  LABEL "Relation between network and Connection Point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {Address}
  COMPONENTS
  {
    ConnectionPoint_Profibus_DP
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 32;
}
```

4.6   Methods

4.6.1   Methods for FDI Communication Servers

4.6.1.1   General

The Communication Server contained Information Model shall implement services according to method signatures described in 4.6.1.

4.6.1.2   Connect

Signature:

```
Connect(
    [in]   ByteString      CommunicationRelationId,
    [in]   byte            Address,
    [in]   UInt16          ManufacturerId,
    [out]  Int32           ServiceError);
```

Table 13 provides the description of the arguments.

Table 13 – 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.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 4.5. The argument value holds the device's network address.
ManufacturerId	The argument shall correspond to BaseDataVariable MANUFACTURER_ID that is organized in the FunctionalGroup Identification (see 5.4.3).
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 device identification

4.6.1.3   Disconnect

Signature:

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

Table 14 provides the description of the arguments.

Table 14 – 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 finding 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

4.6.1.4   Transfer

Signature

```
Transfer(
    [in]   ByteString      CommunicationRelationId,
    [in]   String          OPERATION,
    [in]   unsigned char   SLOT,
    [in]   unsigned char   INDEX,
    [in]   ByteString      REQUEST,
    [out]  ByteString      REPLY,
    [out]  ByteString      RESPONSE_CODES,
    [out]  Int32           ServiceError);
```

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.
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.
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 PROFIBUS specific communication service response bytes.
ServiceError	0: OK/execution finished, RELPLY and RESPONSE_CODES contain the results -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 format

4.6.1.5   GetPublishedData

This method is not supported by PROFIBUS.

4.6.1.6   SetAddress

Signature

```
SetAddress(
    [in]   byte            OldAddress,
    [in]   byte            NewAddress,
    [out]  Int32           ServiceError);
```

Table 16 provides the description of the arguments.

Table 16 – Method SetAddress arguments

Argument	Description
OldAddress	The argument value holds the current address of a device. Allowed values are 0..126.
NewAddress	The argument value holds the new address for a device. Allowed values are 0..125.
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 oldAddress
	-6: SetAddress Failed/duplicate address error
	-7: SetAddress Failed/device did not accept new address
	-8: SetAddress Failed/invalid oldAddress (in terms of syntax, data type, data format, and so on)
	-9: SetAddress Failed/invalid newAddress (in terms of syntax, data type, data format, and so on)
	-10: SetAddress Failed/not possible in status connected

4.6.1.7   Scan

The method signature specified in IEC 62769-7 applies. The corresponding topologyScanResult schema is specified in Clause A.2.

4.6.1.8   ResetScan

The method signature specified in IEC 62769-7 applies.

4.6.2   Methods for Gateways

4.6.2.1   General

The methods signatures defined in 4.6.2 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.

4.6.2.2   Connect

Subclause 4.6.2.2 describes the PROFIBUS Gateway specific implementation of the service Connect specified in IEC 62769-7.

```
METHOD BeginConnect(
    DD_STRING             CommunicationRelationId,
    unsigned char         Address,
    unsigned int          DeviceID
    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 17 provides the description of the arguments.

Table 17 – Connect service 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.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 4.5. The argument value holds the device's network address.
Manufacturerld	The argument shall correspond to BaseDataVariable MANUFACTURER_ID that is organized in the FunctionalGroup Identification (see 5.4.3).
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 service ID -3: Connect Failed/device not found -4: Connect Failed/invalid device address -5: Connect Failed/invalid device identification

4.6.2.3　Disconnect

Subclause 4.6.2.3 describes the PROFIBUS 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 14.

4.6.2.4　Transfer

Subclause 4.6.2.4 describes the PROFIBUS specific implementation of the service Transfer specified in IEC 62769-7.

```
METHOD BeginTransfer(
   DD_STRING              CommunicationRelationId,
   DD_STRING              OPERATION,
   unsigned char          char SLOT,
   unsigned char          char INDEX,
   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,
   DD_STRING              &REPLY,
   DD_STRING              &RESPONSE_CODES,
   unsigned long          ServiceId,
   long                   &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 18 provides the description of the arguments.

Table 18 – 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.
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 corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough 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 PROFIBUS 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.
ServiceError	1: OK/function started asynchronously, result has to be polled with EndTransfer 0: OK/execution finished, ReceivedData contains the result -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 format

4.6.2.5   GetPublishedData

This method is not supported in PROFIBUS.

4.6.2.6   SetAddress

Subclause 4.6.2.6 describes the PROFIBUS specific implementation of the service SetAddress specified in IEC 62769-7.

```
METHOD BeginSetAddress(
   unsigned char          OldAddress,
   unsigned char          NewAddress,
   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>}
}

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

Table 19 provides the description of the arguments.

Table 19 – Method SetAddress arguments

Argument	Description
OldAddress	The argument value holds the current address of a device. Allowed values are 0..126.
NewAddress	The argument value holds the new address for a device. Allowed values are 0..125.
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 oldAddress -6: SetAddress Failed/duplicate address error -7: SetAddress Failed/device did not accept new address -8: SetAddress Failed/invalid oldAddress (in terms of syntax, data type, data format, and so on) -9: SetAddress Failed/invalid newAddress (in terms of syntax, data type, data format, and so on) -10: SetAddress Failed/not possible in status connected

4.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The PROFIBUS 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 in 4.2. The SCAN_LIST attribute inside the COMPONENT declaration shall refer to LIST TopologyScanResult.

```
VARIABLE DP_Address
{
  LABEL "Station address";
  TYPE UNSIGNED_INTEGER(1);
  CLASS LOCAL;
}

VARIABLE DP_DeviceID
{
  LABEL "Device ID";
  TYPE UNSIGNED_INTEGER(2);
  CLASS LOCAL;
}

COLLECTION ScanItemType
{
  MEMBERS
  {
    DP_ADDRESS_ID, DP_Address;
    DP_DEVICE_ID, DP_DeviceID;
  }
}

LIST TopologyScanResult
{
  TYPE ScanItemType;
  CAPACITY 126;
}
```

4.6.2.8   ScanNext

The method signature specified in IEC 62769-7 applies. The PROFIBUS gateway business logic shall create the scan result following IEC 62769-7. The method ScanNext stores the result into data structures described for the method Scan (4.6.2.7).

Annex A
(normative)

Topology Scan result schema

A.1   General

The topology scan result schema specified in Annex A describes the PROFIBUS 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   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:ProfibusNetworkT"/>
```

A.3   ProfibusNetworkT

The element type describes the complete scan result for a single network because of the scan method that is provided per instance of a "Communication Device" which exists in 1:1 relation to a network instance.

The XML schema for a ProfibusNetworkT type is:

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

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

Table A.1 – Elements of ProfibusNetworkT

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.4   ProfibusConnectionPointT

The XML schema for a ProfibusConnectionPointT type is:

```
<xs:complexType name="ProfibusConnectionPointT">
   <xs:sequence>
      <xs:element name="Identification"
         type="PI:ProfibusIdentificationT"/>
```

```
        </xs:sequence>
        <xs:attribute name="Address" type="PI:ProfibusAddressT"
            use="required"/>
</xs:complexType>
```

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

Table A.2 – Attributes of ProfibusConnectionPointT

Attribute	Description
Address	The Attribute value holds the address of the network connected device.

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

Table A.3 – Elements of ProfibusConnectionPointT

Element	Description
Identification	The element data holds the device type identification data. Compared to the Information Model (IEC 62541-100) the ConnectionPoint does not contain or refer to the device type identification data. But in order to support the FDI host system in finding the package that matches the connected device this schema associates the device type identification with the ConnectionPoint.

A.5   ProfibusIdentificationT

The element content corresponds to the "FunctionalGroup Identification".

The XML schema for a ProfibusIdentificationT type is:

```
<xs:complexType name="ProfibusIdentificationT">
    <xs:attribute name="Ident_Number" type="xs:unsignedShort "
        use="required"/>
    <xs:attribute name="MANUFACTURER_ID" type="xs:unsignedShort "
        use="optional"/>
    <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:complexType>
```

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

Table A.4 – Attributes of ProfibusIdentificationT

Attribute	Description
Ident_Number	See Table 10
MANUFACTURER_ID	See Table 10
ORDER_ID	See Table 10
SERIAL_NUMBER	See Table 10
HARDWARE_REVISION	See Table 10
SOFTWARE_REVISION	See Table 10
REV_COUNTER	See Table 10
PROFILE_ID	See Table 10
PROFILE_SPECIFIC_TYPE	See Table 10
IM_VERSION	See Table 10
IM_SUPPORTED	See Table 10

A.6   ProfibusAddressT

The XML schema for a ProfibusAddressT type is:

```
<xs:simpleType name="ProfibusAddressT">
   <xs:restriction base="xs:unsignedByte">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="126"/>
   </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 may not be reflected in the Information Model. The IEC 62769-5 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.

B.2   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.3   xsreceiveData

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.4   xsTransferSendDataT

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
   <xs:attribute name="SLOT" type="xs:unsignedShort" use="required"/>
xs <xs:attribute name="INDEX" type="xs:unsignedShort" use="required"/>
xs <xs:attribute name="REQUEST" type="xs:hexBinary" use="required"/>
xs</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.
INDEX	The attribute corresponds to the Transfer method argument INDEX.
REQUEST	The attribute corresponds to the Transfer method argument REQUEST.

B.5   TransferResultDataT

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

```
<xs:complexType name="TransferResultDataT">
   <xs:attribute name="REPLY" type="xs:hexBinary" use="required"/>
xs <xs:attribute name="RESPONSE_CODES" type="xs:hexBinary"
      use="required"/>
xs
</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.6   OperationT

A simple type that defines possible service operations.

The XML schema for a 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>
```

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[7] To be published.

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Part 103-1: Profiles – PROFIBUS

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International Standard IEC 62769-103-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

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

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

a) support for generic protocol extension for faster adoption of other technologies;

b) support for Package Developers to build EDDs targeted for today's EDD bases system under a single development tool.

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

CDV	Report on voting
65E/622/CDV	65E/685A/RVC 65E/685/RVC

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

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

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

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

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

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FIELD DEVICE INTEGRATION (FDI) –

Part 103-1: Profiles – PROFIBUS

1 Scope

This part of IEC 62769 specifies an FDI profile of IEC 62769 for IEC 61784-1_CP 3/1 (PROFIBUS DP)[1] and IEC 61784-1_CP3/2 (PROFIBUS PA)[1].

2 Normative references

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

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

IEC 62541-100:2015, *OPC Unified Architecture - Part 100*: Device Interface

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

IEC 62769-4[3], *Field Device Integration (FDI) – Part 4: FDI Packages*

IEC 62769-5[4], *Field Device Integration (FDI) – Part 5: FDI Information Model*

IEC 62769-7[5], *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> [viewed 2018-11-23]

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-1, IEC 61804 (all parts), IEC 62541-100, IEC 62769-4, IEC 62769-5, IEC 62769-7 and PI Order No.: 2.122:2008 apply.

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1 PROFIBUS is the trade name of the non-profit consortium PROFIBUS & PROFINET International. 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.

2 Under preparation. Stage at the time of publication: IEC/RFDIS 62769-2:2020.

3 Under preparation. Stage at the time of publication: IEC/RFDIS 62769-4:2020.

4 Under preparation. Stage at the time of publication: IEC/RFDIS 62769-5:2020.

5 Under preparation. Stage at the time of publication: IEC/RFDIS 62769-7:2020.

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

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

3.2   Abbreviated terms and acronyms

For the purposes of this document, the following abbreviations apply:

EDD   Electronic Device Description

EDDL   Electronic Device Description Language (see IEC 61804)

GSD   General station description (see PI Order No.: 2.122:2008)

I&M   Identification and maintenance function

UUID   Universally unique identifier (see ISO/IEC 11578)

XML   Extensible markup language (see REC-xml-20081126)

3.3   Conventions

3.3.1   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.

3.3.2   XML syntax

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

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

3.3.3   Capitalizations

IEC 62769 (all parts) use capitalized terms to emphasize that these terms have a 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 Package.

Parameter names or attributes are concatenated to a single term, where the original terms start 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

• Profibus_PA_Network.

4 Profile for PROFIBUS

4.1 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.

4.2 Catalog profile

4.2.1 Protocol support file

4.2.1.1 FDI Device Package

Protocol specific attachments are mentioned in the Package Catalog as defined in IEC 62769-5. A communication feature list (GSD) file according to PI Order No.: 2.122:2008 is a mandatory attachment for FDI Device Packages representing PROFIBUS DP and PROFIBUS PA devices. Table 1 specifies the parameters of the ProtocolSupportFile in the FDI Device Package.

Table 1 – ProtocolSupportFile for FDI Device Packages

Parameter	Description
Content Type	text/plain
Root Namespace	empty
Source Relationship	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename	According to PI Order No.: 2.122:2008

4.2.1.2 FDI Communication Packages

A GSD file as specified in PI Order No.: 2.122:2008 is an optional attachment for FDI Communication Packages representing PROFIBUS DP and PROFIBUS PA devices. Table 2 specifies the parameters of ProtocolSupportFile for FDI Communication Packages.

Table 2 – ProtocolSupportFile for FDI Communication Packages

Parameter	Description
Content Type:	text/plain
Root Namespace:	empty
Source Relationship:	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Filename:	According to PI Order No.: 2.122:2008

4.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT string for the Catalog XML schema. Table 3 defines the PROFIBUS specific values for this string.

Table 3 – PROFIBUS CommunicationProfile definition schema

Profile Identifier	Protocol
"profibus_dp"	PROFIBUS DP/V0; PROFIBUS DP/V1; PROFIBUS DP/V2
"profibus_pa"	PROFIBUS PA

4.2.3 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 4 focus on catalog content that is vendor independent.

Table 4 – Catalog values for profile devices

Element	Attribute	Content
PackageType	—	Profile
Manufacturer	—	Empty
DeviceModel	—	The allowed profile identifier values (PROFILE_ID) are provided by PROFIBUS & PROFINET International (PI). PI provides and maintains an 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 is connected to the Internet. NOTE More information is provided in PI Order No.: 3.502 (I&M Profile) and related profile definitions are referred therein. The string format shall be hexadecimal starting with 0x, e.g. '0x3D00'.

4.2.4 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 5 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 5 – Version mapping examples[6]

Protocol / Version	InterfaceT Version value
PROFIBUS DP/V0	0.0.0[a]
PROFIBUS DP/V1	1.0.0[a]
PROFIBUS DP/V2	2.0.0[a]
PROFIBUS PA 3.02	3.2.0[b]

[a]   The protocols PROFIBUS DP/V0, PROFIBUS DP/V1 and PROFIBUS DP/V2 contain a single number. This number is considered to be the major version. The minor and built numbers are set to "0".

[b]   The currently known PROFIBUS PA profile number is considered to provide major and minor version information. Leading zeros are not considered in version value evaluation since only the actual decimal values are relevant.

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[6]   The given table can be considered to be an example only since this document cannot foresee how future protocol versions will be defined.

4.3 Associating a Package with a device

4.3.1 Device type identification mapping

The purpose of 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 4.6.1.7) provides the scan result through an XML document (the schema is defined in Clause A.5).

The Gateway implemented scan service (defined in 4.6.2.7) provides the scan result by means of the Information Model that contains data structures created from EDD content as specified in 4.6.2.7.

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:

c) 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 catalog information.

d) 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 device type information presented in scan result (see the identification in Clause A.5) 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 scan result based on the Catalog Schema in IEC 62769-4 defining the XML (simple) element types "DeviceModel" and "Manufacturer". Both types are used in the (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 the specified FunctionalGroup Identification containing Ident_Number and Manufacturer_ID (see 4.4.3). The Ident_Number matches with the GSD specified Ident_Number. Manufacturer_ID is specified through the I&M profile defined VendorID and DeviceID (see 4.4.3).

The mapping between different device identification data sources is described in Table 6. 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.

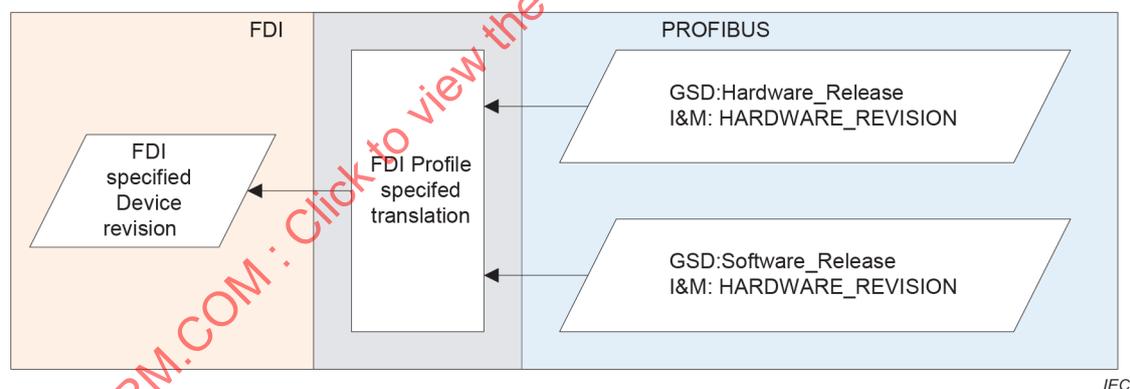**Table 6 – Device identification information mapping**

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

4.3.2 Device type revision mapping

IEC 62769-4 envisions a concept that allows to determine 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.

NOTE PROFIBUS related specifications, for example PI Order No.: 2.122:2008 (GSD) and PI Order No.: 3.502:2009 (I&M) splits the device type revision into software and hardware related information. The GSD specifies the attributes Hardware_Release and Software_Release. The I&M specifies HARDWARE_REVISION and SOFTWARE_REVISION. Hardware_Release and HARDWARE_REVISION will always match. Software_Release and SOFTWARE_REVISION will always match.

The goal of 4.3.2 is to describe the translation rules between PROFIBUS related specifications, describing their way of providing the version information, and the IEC 62769-4 specified way of containing the version information that can be compared against the version read from the device. The purpose is to determine the compatibility between an FDI Device Package and a Device. Figure 1 depicts the problem.

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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 PROFIBUS PA profile enables the reading of the values SOFTWARE_REVISION and HARDWARE_REVISION. The access to these values shall be described in the EDD contained in the FDI Device Package.

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 and Software_Release.

Hardware related modifications shall be captured in the HARDWARE_REVISION and Hardware_Release. Hardware related modifications do not necessarily always require a firmware update. Thus HARDWARE_REVISION and Hardware_Release 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. Hardware_Release and Software_Release shall be changed accordingly.

The IEC 62769-4 specifies the Catalog schema and an element DeviceVersion which is used in the element type declaration ListOfSupportedDeviceVersions. The value of the DeviceVersion shall be compared to the device provided SOFTWARE_REVISION or the GSD provided Software_Release 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.

4.4 Information Model mapping

4.4.1 ProtocolType definition

The concept to derive PROFIBUS DP and PROFIBUS PA specific Network Types applies to the protocol type definition.

The protocol type Profibus_DP shall be used to identify the PROFIBUS DP communication. The type Profibus_DP is a sub type of the abstract type ProtocolType in IEC 62541-100. Table 7 specifies the allowed values of the ProtocolType attributes for the protocol type Profibus_DP.

Table 7 – Protocol type Profibus_DP

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

The network type Profibus_PA_Network shall be used to build PROFIBUS PA network topologies. The type Profibus_DP_Network is a sub type of the abstract type NetworkType in IEC 62541-100. Table 8 specifies the allowed values of the ProtocolType attributes for the protocol type Profibus_PA.

Table 8 – Protocol type Profibus_PA

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

4.4.2   DeviceType mapping

The DeviceType property mapping of the DeviceType node is defined in Table 9.

Table 9 – DeviceType property mapping

Property	PROFIBUS Mapping
SerialNumber	SERIAL_NUMBER (see Table 10)
RevisionCounter	REV_COUNTER (see Table 10)
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 10)
HardwareRevision	HARDWARE_REVISION (see Table 10)

4.4.3   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 PROFIBUS devices types as follows:

Table 10 – PROFIBUS Device Types identification attributes

BrowseName	DataType	Mandatory/Optional
Ident_Number	UInt16	Mandatory
MANUFACTURER_ID	UInt16	Mandatory
ORDER_ID	String	Optional
SERIAL_NUMBER	String	Optional
HARDWARE_REVISION	UInt16	Optional
SOFTWARE_REVISION	String	Optional
REV_COUNTER	UInt16	Optional
PROFILE_ID	UInt16	Optional
PROFILE_SPECIFIC_TYPE	UInt16	Optional
IM_VERSION	ByteString	Optional
IM_SUPPORTED	UInt16	Optional

The BaseDataVariable instances, except Ident_Number, shall be created from VARIABLE declarations with identifiers that correspond to the browse names listed in Table 10. The BaseDataVariable instances Ident_Number shall be created from the GSD file attribute Ident_Number.

4.5   Topology elements

4.5.1   ConnectionPoint definition

In order to support different network topology engineering needs related to different physical layers used by PROFIBUS DP and PROFIBUS PA, two different ConnectionPoint types shall be defined.

The ConnectionPoint type Profibus_DP shall be used to parameterize PROFIBUS DP network access points. The ConnectionPoint type Profibus_DP is a sub type of the abstract type ConnectionPointType defined in IEC 62541-100. Table 11 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profibus_DP.

Table 11 – ConnectionPoint type for Profibus_DP

Attribute	Value				
BrowseName	ConnectionPoint_Profibus_DP				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Sub type of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	Address	Byte	PropertyType	Mandatory

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

```
COMPONENT ConnectionPoint_Profibus_DP
{
  LABEL "PROFIBUS DP Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL PROFIBUS_DP;
  CONNECTION_POINT ConnectionPoint;
}

VARIABLE Address
{
  LABEL "Station address";
  HELP "Address of the PROFIBUS slave";
  TYPE UNSIGNED_INTEGER(1)
  {
    INITIAL_VALUE 126;
    MIN_VALUE 0;
    MAX_VALUE 126;
  }
  HANDLING READ & WRITE;
  CLASS LOCAL;
}


COLLECTION ConnectionPoint
{
  LABEL "PROFIBUS DP Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_ADDRESS, Address;
  }
}
```

The ConnectionPoint type Profibus_PA shall be used to parameterize PROFIBUS PA network access points. The ConnectionPoint type Profibus_PA is a sub type of the abstract type

ConnectionPointType defined in IEC 62541-100. Table 12 specifies the allowed values of the ConnectionPoint attributes for the protocol type Profibus_PA.

Table 12 – ConnectionPoint type for Profibus_PA

Attribute	Value				
BrowseName	ConnectionPoint_Profibus_PA				
IsAbstract	False				
References	**NodeClass**	**BrowseName**	**DataType**	**TypeDefinition**	**ModellingRule**
Subtype of the ConnectionPointType defined in IEC 62541-100.					
HasProperty	Variable	Address	Byte	PropertyType	Mandatory

The Property Address allowed values are 0..126.

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

```
COMPONENT ConnectionPoint_Profibus_PA
{
  LABEL "PROFIBUS PA Connection Point";
  CLASSIFICATION NETWORK_CONNECTION_POINT;
  CAN_DELETE FALSE;
  PROTOCOL PROFIBUS_PA;
}

VARIABLE Address
{
  LABEL "Station address";
  HELP "Address of the PROFIBUS slave";
  CLASS DEVICE;
  TYPE UNSIGNED_INTEGER(1)
  {
    INITIAL_VALUE 126;
    MIN_VALUE 0;
    MAX_VALUE 126;
  }
  HANDLING READ & WRITE;
  CLASS LOCAL;
}

COLLECTION ConnectionPoint
{
  LABEL "PROFIBUS PA Connection Point data";
  MEMBERS
  {
    CONNECTION_POINT_ADDRESS, Address;
  }
}
```

4.5.2   Communication Device definition

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

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


COMPONENT_RELATION Profibus_Communication_Device_Setup
{
  LABEL "Relation between Device and communication device";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
      Profibus_Communication_Device{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 4;
}
```

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 in is an example for a PROFIBUS DP communication device:

```
COMPONENT Profibus_Communication_Device
{
  LABEL "PROFIBUS communication device";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS { Profibus_Service_Provider_Relation }
  BYTE_ORDER BIG_ENDIAN;
}


COMPONENT_RELATION Profibus_Service_Provider_Relation
{
  LABEL "Relation to communication service provider";
  RELATION_TYPE CHILD_COMPONENT;
  COMPONENTS
  {
      Profibus_Service_Provider{AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}
```

In an actual communication device the value "ConnectionPoint_Profibus_DP" needs to be adapted according to the supported protocol and the related connection point definitions given in 4.5. The attribute BYTE_ORDER value is to be set according to the protocol.

4.5.3   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 below is an example for a PROFINET IO communication service provider component:

The component reference (ConnectionPoint_Profibus_DP) corresponds to the related connection point definition in 4.5. The attribute BYTE_ORDER value is to be set according to the protocol.

```
COMPONENT Profibus_Service_Provider
{
  LABEL "PROFIBUS communication service provider";
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMMUNICATION_SERVICE_PROVIDER;
  COMPONENT_RELATIONS
  {
    Profibus_Service_Provider_Connection_Point_Relation
  }
  BYTE_ORDER BIG_ENDIAN; // EDDL extension
}

COMPONENT_RELATION Profibus_Service_Provider_Connection_Point_Relation
{
  LABEL "Relation between communication service provider and Connection Point";
  RELATION_TYPE CHILD_COMPONENT;
  ADDRESSING {Address}
  COMPONENTS
  {
    ConnectionPoint_Profibus_DP{ AUTO_CREATE 1;}
  }
  MINIMUM_NUMBER 1;
  MAXIMUM_NUMBER 1;
}
```

4.5.4   Network definition

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

```
COMPONENT Network_Profibus_DP
{
    LABEL "PROFIBUS DP Network";
    CAN_DELETE TRUE;
    CLASSIFICATION NETWORK;
    COMPONENT_RELATIONS
    {
      Profibus_DP_Network_Connection_Point_Relation
    }
}

COMPONENT_RELATION Profibus_DP_Network_Connection_Point_Relation
{
    LABEL "Relation between network and Connection Point";
    RELATION_TYPE CHILD_COMPONENT;
    ADDRESSING {Address}
    COMPONENTS
    {
      ConnectionPoint_Profibus_DP
    }
    MINIMUM_NUMBER 1;
    MAXIMUM_NUMBER 32;
}
```

4.6   Methods

4.6.1   Methods for FDI Communication Servers

4.6.1.1   General

The Communication Server contained Information Model shall implement services according to method signatures described in 4.6.1.

4.6.1.2   Connect

Signature:

```
Connect(
    [in]   ByteString      CommunicationRelationId,
    [in]   byte            Address,
    [out]  Int32           ServiceError);
```

Table 13 provides the description of the arguments.

Table 13 – 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.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 4.5. The argument value holds the device's network address.
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 device identification

4.6.1.3   Disconnect

Signature:

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

Table 14 provides the description of the arguments.

Table 14 – 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 finding 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

4.6.1.4   Transfer

Signature

```
Transfer(
    [in]   ByteString      CommunicationRelationId,
    [in]   String          OPERATION,
    [in]   unsigned char   SLOT,
    [in]   unsigned char   INDEX,
```

```
[in]   ByteString        REQUEST,
[out]  ByteString        REPLY,
[out]  ByteString        RESPONSE_CODES,
[out]  Int32             ServiceError);
```

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 of COMMAND – attribute SLOT 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.
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 PROFIBUS 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 format

4.6.1.5   GetPublishedData

This method is not supported by PROFIBUS.

4.6.1.6   SetAddress

Signature

```
SetAddress(
   [in]   byte              OldAddress,
   [in]   byte              NewAddress,
   [out]  Int32             ServiceError);
```

Table 16 provides the description of the arguments.

Table 16 – Method SetAddress arguments

Argument	Description
OldAddress	The argument value holds the current address of a device. Allowed values are 0..126.
NewAddress	The argument value holds the new address for a device. Allowed values are 0..125.
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 oldAddress
	-6: SetAddress Failed/duplicate address error
	-7: SetAddress Failed/device did not accept new address
	-8: SetAddress Failed/invalid oldAddress (in terms of syntax, data type, data format, and so on)
	-9: SetAddress Failed/invalid newAddress (in terms of syntax, data type, data format, and so on)
	-10: SetAddress Failed/not possible in status connected

4.6.1.7   Scan

The method signature specified in IEC 62769-7 applies. The corresponding topologyScanResult schema is specified in Clause A.2.

4.6.1.8   ResetScan

The method signature specified in IEC 62769-7 applies.

4.6.2   Methods for Gateways

4.6.2.1   General

The methods signatures defined in 4.6.2 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.

4.6.2.2   Connect

Subclause 4.6.2.2 describes the PROFIBUS Gateway specific implementation of the service Connect specified in IEC 62769-7.

```
METHOD BeginConnect(
    DD_STRING            CommunicationRelationId,
    unsigned char        Address,
    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 17 provides the description of the arguments.

Table 17 – Connect service 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.
Address	The argument name shall match with the corresponding attribute name defined for the ConnectionPoint which is described by a corresponding EDD element specified in 4.5. The argument value holds the device's network address.
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 service ID -3: Connect Failed/device not found -4: Connect Failed/invalid device address -5: Connect Failed/invalid device identification

4.6.2.3   Disconnect

Subclause 4.6.2.3 describes the PROFIBUS 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 14.

4.6.2.4 Transfer

Subclause 4.6.2.4 describes the PROFIBUS specific implementation of the service Transfer specified in IEC 62769-7.

```
METHOD BeginTransfer(
   DD_STRING              CommunicationRelationId,
   DD_STRING              OPERATION,
   unsigned char         SLOT,
   unsigned char         INDEX,
   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,
   DD_STRING             &REPLY,
   DD_STRING             &RESPONSE_CODES,
   unsigned long         ServiceId,
   long                  &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}
```

Table 18 provides the description of the arguments.

Table 18 – 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.
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.

Argument	Description
REQUEST	The argument name shall match with corresponding COMMAND sub-element name REQUEST. The byte stream submitted trough 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 PROFIBUS 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.
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 format

4.6.2.5   GetPublishedData

This method is not supported in PROFIBUS.

4.6.2.6   SetAddress

Subclause 4.6.2.6 describes the PROFIBUS specific implementation of the service SetAddress specified in IEC 62769-7.

```
METHOD BeginSetAddress(
   unsigned char          OldAddress,
   unsigned char          NewAddress,
   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 19 provides the description of the arguments.

Table 19 – Method SetAddress arguments

Argument	Description
OldAddress	The argument value holds the current address of a device. Allowed values are 0..126.
NewAddress	The argument value holds the new address for a device. Allowed values are 0..125.
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 oldAddress
	-6: SetAddress Failed/duplicate address error
	-7: SetAddress Failed/device did not accept new address
	-8: SetAddress Failed/invalid oldAddress (in terms of syntax, data type, data format, and so on)
	-9: SetAddress Failed/invalid newAddress (in terms of syntax, data type, data format, and so on)
	-10: SetAddress Failed/not possible in status connected

4.6.2.7 Scan

The method signature specified in IEC 62769-7 applies. The PROFIBUS 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 in 4.2. The SCAN_LIST attribute inside the COMPONENT declaration shall refer to LIST TopologyScanResult.

```
VARIABLE DP_Address
{
  LABEL "Station address";
  TYPE UNSIGNED_INTEGER(1);
  CLASS LOCAL;
}

VARIABLE DP_DeviceID
{
  LABEL "Device ID";
  TYPE UNSIGNED_INTEGER(2);
  CLASS LOCAL;
}

COLLECTION ScanItemType
{
```

```
  MEMBERS
  {
    DP_ADDRESS_ID, DP_Address;
    DP_DEVICE_ID, DP_DeviceID;
  }
}

LIST TopologyScanResult
{
  TYPE ScanItemType;
  CAPACITY 126;
}
```

4.6.2.8   ScanNext

The method signature specified in IEC 62769-7 applies. The PROFIBUS gateway business logic shall create the scan result following IEC 62769-7. The method ScanNext stores the result into data structures described for the method Scan (4.6.2.7).

Annex A
(normative)

Topology Scan result schema

A.1   General

The topology scan result schema specified in Annex A describes the PROFIBUS 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   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:ProfibusNetworkT"/>
```

A.3   ProfibusNetworkT

The element type describes the complete scan result for a single network because of the scan method that is provided per instance of a "Communication Device" which exists in 1:1 relation to a network instance.

The XML schema for a ProfibusNetworkT type is:

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

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

Table A.1 – Elements of ProfibusNetworkT

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.4   ProfibusConnectionPointT

The XML schema for a ProfibusConnectionPointT type is:

```
<xs:complexType name="ProfibusConnectionPointT">
   <xs:sequence>
      <xs:element name="Identification"
         type="PI:ProfibusIdentificationT"/>
```

```
      </xs:sequence>
      <xs:attribute name="Address" type="PI:ProfibusAddressT"
         use="required"/>
</xs:complexType>
```

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

Table A.2 – Attributes of ProfibusConnectionPointT

Attribute	Description
Address	The Attribute value holds the address of the network connected device.

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

Table A.3 – Elements of ProfibusConnectionPointT

Element	Description
Identification	The element data holds the device type identification data. Compared to the Information Model (IEC 62541-100) the ConnectionPoint does not contain or refer to the device type identification data. But in order to support the FDI host system in finding the package that matches the connected device this schema associates the device type identification with the ConnectionPoint.

A.5   ProfibusIdentificationT

The element content corresponds to the "FunctionalGroup Identification".

The XML schema for a ProfibusIdentificationT type is:

```
<xs:complexType name="ProfibusIdentificationT">
   <xs:attribute name="Ident_Number" type="xs:unsignedShort "
      use="required"/>
   <xs:attribute name="MANUFACTURER_ID" type="xs:unsignedShort "
      use="optional"/>
   <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:complexType>
```

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

Table A.4 – Attributes of ProfibusIdentificationT

Attribute	Description
Ident_Number	See Table 10
MANUFACTURER_ID	See Table 10
ORDER_ID	See Table 10
SERIAL_NUMBER	See Table 10
HARDWARE_REVISION	See Table 10
SOFTWARE_REVISION	See Table 10
REV_COUNTER	See Table 10
PROFILE_ID	See Table 10
PROFILE_SPECIFIC_TYPE	See Table 10
IM_VERSION	See Table 10
IM_SUPPORTED	See Table 10

A.6   ProfibusAddressT

The XML schema for a ProfibusAddressT type is:

```
<xs:simpleType name="ProfibusAddressT">
   <xs:restriction base="xs:unsignedByte">
      <xs:minInclusive value="0"/>
      <xs:maxInclusive value="126"/>
   </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 may not be reflected in the Information Model. The IEC 62769-5 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.

B.2   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.3   xsreceiveData

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.4   xsTransferSendDataT

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
   <xs:attribute name="SLOT" type="xs:unsignedShort" use="required"/>
xs <xs:attribute name="INDEX" type="xs:unsignedShort" use="required"/>
xs <xs:attribute name="REQUEST" type="xs:hexBinary" use="required"/>
xs</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.
INDEX	The attribute corresponds to the Transfer method argument INDEX.
REQUEST	The attribute corresponds to the Transfer method argument REQUEST.

B.5 TransferResultDataT

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

```
<xs:complexType name="TransferResultDataT">
   <xs:attribute name="REPLY" type="xs:hexBinary" use="required"/>
xs <xs:attribute name="RESPONSE_CODES" type="xs:hexBinary"
     use="required"/>
xs
</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.6 OperationT

A simple type that defines possible service operations.

The XML schema for a 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>
```

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI) –

Partie 103-1: Profils – PROFIBUS

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

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

a) prise en charge d'extensions de protocoles génériques, pour une adoption plus rapide d'autres technologies;

b) capacité offerte aux Développeurs de Paquetages d'élaborer des EDD ciblant les systèmes actuels de bases EDD, en exploitant un seul outil de développement.

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

CDV	Rapport de vote
65E/622/CDV	65E/685A/RVC 65E/685/RVC

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

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

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INTÉGRATION DES APPAREILS DE TERRAIN (FDI) –

Partie 103-1: Profils – PROFIBUS

1 Domaine d'application

La présente partie de l'IEC 62769 spécifie un profil FDI de l'IEC 62769 pour l'IEC 61784-1_CP 3/1 (PROFIBUS DP)[1] et l'IEC 61784-1_CP 3/2 (PROFIBUS PA)[1].

2 Références normatives

Les documents suivants cités dans le texte 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 61804 (toutes les parties), *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[2], *Intégration des appareils de terrain (FDI) – Partie 2: Client FDI*

IEC 62769-4[3], *Intégration des appareils de terrain (FDI) – Partie 4: Paquetages FDI*

IEC 62769-5[4], *Intégration des appareils de terrain (FDI) – Partie 5: Modèle d'Information FDI*

IEC 62769-7[5], *Intégration des appareils de terrain (FDI) – Partie 7: Appareils de communication FDI*

Spécification PI N° 2.122:2008, *Specification for PROFIBUS – Device Description and Device Integration – Volume 1: GSD Specification, V5.1, juillet 2008, GSD;* disponible à l'adresse <www.profibus.com> (disponible en anglais seulement) [consultée 2018-11-23]

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2   En cours de préparation. Stade au moment de la publication: IEC/RFDIS 62769-2:2020.

3   En cours de préparation. Stade au moment de la publication: IEC/RFDIS 62769-4:2020.

4   En cours de préparation. Stade au moment de la publication: IEC/RFDIS 62769-5:2020.

5   En cours de préparation. Stade au moment de la publication: IEC/RFDIS 62769-7:2020.

3   Termes, définitions, abréviations et conventions

3.1   Termes et définitions

Pour les besoins du présent document, les termes et définitions donnés dans l'IEC 61784-1, l'IEC 61804 (toutes les parties), l'IEC 62541-100, l'IEC 62769-4, l'IEC 62769-5, l'IEC 62769-7 et la spécification PI N° 2.122 (2008) 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 suivantes s'appliquent:

EDD   Description d'appareil électronique (Electronic Device Description)

EDDL   Langage de description d'appareil électronique (Electronic Device Description Language, voir l'IEC 61804)

GSD   Description générale de station (General Station Description, voir Spécification PI No 2.122:2008)

I&M   Fonction d'identification et de maintenance

UUID   Identificateur universel unique (Universally Unique Identifier, voir l'ISO/IEC 11578)

XML   Langage de balisage extensible (eXtensible Markup Language, voir REC-xml-20081126)

3.3   Conventions

3.3.1   Syntaxe EDDL

Le présent document spécifie le contenu du composant EDD qui fait partie des Paquetages de Communication FDI. Le contenu de la spécification utilisant la syntaxe EDDL applique une police `Courier New`. La syntaxe EDDL est utilisée pour les déclarations des signatures de méthodes, des variables, des structures de données et des composants.

3.3.2   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">`

3.3.3   Majuscules

L'IEC 62769 (toutes les parties) utilise des termes en majuscules pour souligner que ces termes ont une signification spécifique à la FDI.

Certains de ces termes utilisent un acronyme comme suffixe, 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 terme, dans lequel les différents termes d'origine commencent par une lettre majuscule, par exemple:

- ProtocolSupportFile, ou

- ProtocolType.

Les noms de paramètres ou attributs peuvent aussi être construits en utilisant le caractère de soulignement pour concaténer au moins deux termes, par exemple:

- PROFILE_ID, ou

- Profibus_PA_Network.

4   Profil pour PROFIBUS

4.1   Généralités

Le présent document de profil, conforme à la spécification FDI de l'IEC 62769, spécifie les spécificités du protocole nécessaires aux Paquetages FDI décrivant des Serveurs de Communication, des Passerelles et des Appareils.

Pour les Serveurs de Communication, le présent document définit également des spécificités de protocole lorsqu'elles ont besoin d'être prises en considération dans le Modèle d'Information hébergé sur les Serveurs de Communication.

4.2   Profil de catalogue

4.2.1   Fichier de prise en charge de protocole

4.2.1.1   Paquetage d'Appareil FDI

Les pièces jointes spécifiques à un protocole sont mentionnées dans le Catalogue de Paquetage défini dans l'IEC 62769-5. Un fichier GSD contenant la liste des fonctionnalités de communication, établi conformément à Spécification PI No 2.122:2008 est une pièce jointe obligatoire pour les Paquetages d'Appareils FDI représentant des appareils PROFIBUS DP et PROFIBUS PA. 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/texte brut
Espace de noms racine	vide
Relation source	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Nom de fichier	Conformément à la spécification PI No Spécification PI No 2.122:2008

4.2.1.2   Paquetages de Communication FDI

Un fichier GSD tel que spécifié dans Spécification PI No 2.122:2008 est une pièce jointe facultative pour les Paquetages de Communication FDI représentant des appareils PROFIBUS DP et PROFIBUS PA. 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/texte brut
Espace de noms racine	vide
Relation source	http://fdi-cooperation.com/2010/relationship/attachment-protocol
Nom de fichier	Conformément à la spécification PI No Spécification PI No 2.122:2008

4.2.2   Définition de CommunicationProfile

L'IEC 62769-4 définit une chaîne CommunicationProfileT pour le schéma XML Catalog. Le Tableau 3 définit les valeurs spécifiques à PROFIBUS pour cette chaîne.

Tableau 3 – Schéma de définition pour PROFIBUS CommunicationProfile

Identificateur de profil	Protocole
"profibus_dp"	PROFIBUS DP/V0; PROFIBUS DP/V1; PROFIBUS DP/V2
"profibus_pa"	PROFIBUS PA

4.2.3   Appareil de profil

Un Paquetage de Profil doit fournir les valeurs de catalogue pour les appareils de profil, permettant au Serveur FDI d'exploiter une description d'appareil générique, si une description spécifique n'est pas disponible. Les définitions du Tableau 4 sont axées sur le contenu du catalogue qui est indépendant du fournisseur.

Tableau 4 – Valeurs de catalogue pour les appareils de profil

Elément	Attribut	Contenu
PackageType	—	Profil
Manufacturer	—	Vide
DeviceModel	—	Les valeurs d'identificateur de profil autorisées (PROFILE_ID) sont fournies par PROFIBUS & PROFINET International (PI). PI fournit et maintient un fichier XML (Profile_ID_Table) contenant l'assignation 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 un quelconque outil technique ou outil de service, dès lors qu'il est connecté à Internet. NOTE De plus amples informations sont fournies dans la spécification PI N° 3.502 (profil I&M) et les définitions de profils connexes y sont référencées. La chaîne doit être au format hexadécimal en commençant par 0x, par exemple "0x3D00".

4.2.4   Informations relatives à la version de 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 est censé fournir des informations de version relatives au profil de protocole de communication appliqué. La valeur suit le schéma d'informations de version défini par l'IEC 62769-4, lequel schéma est défini dans le type d'élément VersionT. Le Tableau 5 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 appliquer 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 5 – Exemples de mapping de versions[6]

Protocole/version	Valeur de l'élément InterfaceT Version
PROFIBUS DP/V0	0.0.0[a]
PROFIBUS DP/V1	1.0.0[a]
PROFIBUS DP/V2	2.0.0[a]
PROFIBUS PA 3.02	3.2.0[b]
[a] La version des protocoles PROFIBUS DP/V0, PROFIBUS DP/V1 et PROFIBUS DP/V2 n'est composée que d'un seul chiffre. Ce chiffre est considéré comme étant la version majeure. Les numéros de version mineure et de build (mouture) sont mis à "0".	
[b] Le numéro de profil PROFIBUS PA actuellement connu est considéré fournir 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.	

4.3 Association d'un Paquetage avec un appareil

4.3.1 Mapping d'identification du type d'appareil

Le but du mapping de l'identification de type d'appareil est de permettre aux systèmes Hôtes FDI de comparer le résultat de balayage à la représentation de la topologie dans le Modèle d'Information. Les systèmes Hôtes FDI doivent également être habilités à déterminer le Paquetage d'Appareil FDI qui est adapté à 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 par le Serveur de Communication (défini en 4.6.1.7) fournit le résultat de balayage par le biais d'un document XML (le schéma est défini à l'Article A.5).

Le service de balayage mis en œuvre par la Passerelle (défini en 4.6.2.7) fournit le résultat de balayage au moyen du Modèle d'Information qui contient des structures de données créées à partir du contenu EDD tel que spécifié en 4.6.2.7.

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

Les systèmes Hôtes FDI qui comparent la configuration de la topologie réelle du réseau à la représentation de la topologie dans le Modèle d'Information doivent être habilités à traiter 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 (comme Instance): permettre au système Hôte FDI de trouver le Paquetage d'Appareil FDI approprié en fonction des informations du catalogue d'appareil;

b) l'instance d'Appareil physique identifiée par l'adresse d'appareil est logiquement présente dans le Modèle d'Information (comme Instance): permettre au système Hôte FDI de comparer les informations de type d'appareil présentées dans le résultat de balayage (voir l'identification à l'Article A.5) et les informations spécifiques à un type d'appareil de l'Instance présente dans le Modèle d'Information.

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[6] Le tableau donné peut être considéré comme étant uniquement un exemple, car le présent document ne peut pas prévoir comment les futures versions de protocole seront définies.

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

Suite au déploiement du Paquetage FDI, les informations de Paquetage FDI sont alors présentes dans le Modèle d'Information sous la forme du FunctionalGroup "Identification" spécifié, contenant Ident_Number et Manufacturer_ID (voir 4.4.3). L'Ident_Number concorde avec l'Ident_Number spécifié par la GSD. Le Manufacturer_ID est spécifié par le biais de VendorID et de DeviceID, définis par le profil I&M (voir 4.4.3).

Le mapping entre différentes sources de données d'identification d'appareils est décrit dans le Tableau 6. Comme les résultats de balayage fournis par le Serveur de Communication ou la Passerelle peuvent acheminer des données qui sont produites par l'appareil (micrologiciel), le mapping d'identification de type d'appareil doit être pris en charge en fournissant les données correspondantes dans le Catalogue et le Modèle d'Information contenus dans le Paquetage d'Appareil FDI.

**Tableau 6 – Mapping des informations d'identification d'appareils**

Paquetage d'Appareil FDI	Modèle d'Information	Résultat de balayage fourni par le Serveur de Communication	Résultat de balayage fourni par la Passerelle
Type spécifié dans Catalog Manufacturer	FunctionalGroup: Identification Nom d'exploration: Manufacturer_ID	Elément (chemin): ConnectionPoint/Identification Attribut: Manufacturer_ID	COLLECTION ConnectionPoint. Identification. Manufacturer_ID
Type spécifié dans Catalog DeviceModel	FunctionalGroup: Identification Nom d'exploration: Ident_Number	Elément (chemin): ConnectionPoint/Identification Attribut: Ident_Number	COLLECTION ConnectionPoint. Identification. Ident_Number

4.3.2 Mapping des révisions 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 portant sur une seule information de version fournie pour l'appareil complet.

NOTE Les spécifications PROFIBUS, par exemple Spécification PI No 2.122:2008 (concernant la GSD) et 3.502:2009 (concernant le profil I&M), divisent la révision de type d'appareil en informations relatives au logiciel et en informations relatives au matériel. La GSD spécifie les attributs Hardware_Release et Software_Release. Le profil I&M spécifie HARDWARE_REVISION et SOFTWARE_REVISION. Hardware_Release et HARDWARE_REVISION concordent. Software_Release et SOFTWARE_REVISION concordent toujours.

L'objectif de 4.3.2 est de décrire les règles de traduction entre les spécifications PROFIBUS, en décrivant leur manière de fournir les informations de version, et la manière spécifiée par l'IEC 62769-4 en ce qui concerne les informations de version qui peuvent être comparées par rapport à la version lue dans l'appareil. Le but est de déterminer la compatibilité entre un Paquetage d'Appareil FDI et un Appareil. La Figure 1 décrit le problème.
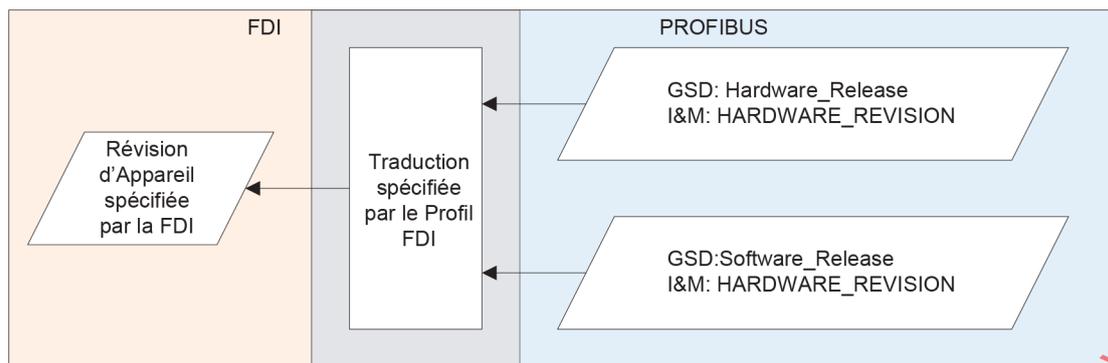
Figure 1 – Problème de mapping des versions

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 PROFIBUS PA 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 de micrologiciel qui affectent 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 les attributs SOFTWARE_REVISION et Software_Release.

Les modifications relatives au matériel doivent être collectées dans les attributs HARDWARE_REVISION et Hardware_Release. Les modifications relatives au matériel n'exigent pas nécessairement une mise à jour de micrologiciel. Par conséquent, HARDWARE_REVISION et Hardware_Release ne peuvent pas être utilisés 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. Hardware_Release et Software_Release doivent être modifiés en conséquence.

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, ou à l'attribut Software_Release fourni par la GSD, 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", et aucune autre représentation telle qu'un 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 et un espace doivent être ignorés. Dans le cas d'une chaîne figurant dans un autre format, le numéro de révision ne doit pas être pris en compte pour sélectionner le Paquetage FDI adéquat.

4.4 Mapping du Modèle d'Information

4.4.1 Définition de ProtocolType

Le concept pour dériver les Types de Réseaux spécifiques à PROFIBUS DP et PROFIBUS PA s'applique à la définition du type de protocole.

Le type de protocole Profibus_DP doit être utilisé pour identifier la communication PROFIBUS DP. Le type Profibus_DP est un sous-type du type abstrait ProtocolType défini dans l'IEC 62541-100. Le Tableau 7 spécifie les valeurs autorisées des attributs ProtocolType pour le type de protocole Profibus_DP.

Tableau 7 – Type de protocole Profibus_DP

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

Le type de réseau Profibus_PA_Network doit être utilisé pour construire des topologies de réseau PROFIBUS PA. Le type Profibus_DP_Network est un sous-type du type abstrait NetworkType défini dans l'IEC 62541-100. Le Tableau 8 spécifie les valeurs autorisées des attributs ProtocolType pour le type de protocole Profibus_PA.

Tableau 8 – Type de protocole Profibus_PA

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

4.4.2 Mapping de DeviceType

Le mapping des propriétés DeviceType du nœud DeviceType est défini dans le Tableau 9.

Tableau 9 – Mapping des propriétés DeviceType

Propriété	Mapping PROFIBUS
SerialNumber	SERIAL_NUMBER (voir Tableau 10)
RevisionCounter	REV_COUNTER (voir Tableau 10)
Manufacturer	Chaîne obtenue à partir du catalogue de paquetages FDI (élément ManufacturerName issu de PackageT)
Model	Chaîne obtenue à partir du catalogue de paquetages FDI (élément Name de DeviceTypeT, qui est un nom localisé)
DeviceRevision	Non prise en charge
DeviceManual	Non prise en charge
SoftwareRevision	SOFTWARE_REVISION (voir Tableau 10)
HardwareRevision	HARDWARE_REVISION (voir Tableau 10)

4.4.3　Définition du FunctionalGroup "Identification"

Comme défini au Paragraphe 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 à un protocole, appelé Identification. Les paramètres de ce FunctionalGroup sont définis pour les types d'appareils PROFIBUS comme suit:

Tableau 10 – Attributs d'identification pour les types d'appareils PROFIBUS

BrowseName	DataType	Obligatoire/facultatif
Ident_Number	UInt16	Obligatoire
MANUFACTURER_ID	UInt16	Obligatoire
ORDER_ID	String	Facultatif
SERIAL_NUMBER	String	Facultatif
HARDWARE_REVISION	UInt16	Facultatif
SOFTWARE_REVISION	String	Facultatif
REV_COUNTER	UInt16	Facultatif
PROFILE_ID	UInt16	Facultatif
PROFILE_SPECIFIC_TYPE	UInt16	Facultatif
IM_VERSION	ByteString	Facultatif
IM_SUPPORTED	UInt16	Facultatif

Les instances de BaseDataVariable, sauf Ident_Number, doivent être créées à partir des déclarations de VARIABLE avec des identificateurs qui correspondent aux noms d'exploration énumérés dans le Tableau 10. Les instances Ident_Number de BaseDataVariable doivent être créées à partir de l'attribut Ident_Number du fichier GSD.

4.5　Eléments de topologie

4.5.1　Définition de ConnectionPoint

Afin de prendre en charge les différents besoins d'ingénierie de topologie réseau relatifs aux différentes couches physiques utilisées par PROFIBUS DP et PROFIBUS PA, deux types différents de ConnectionPoint doivent être définis.

Le type de ConnectionPoint Profibus_DP doit être utilisé pour paramétrer les points d'accès réseau PROFIBUS DP. Le type de ConnectionPoint Profibus_DP est un sous-type du type abstrait ConnectionPointType défini dans l'IEC 62541-100. Le Tableau 11 spécifie les valeurs autorisées des attributs ConnectionPoint pour le type de protocole Profibus_DP.

Tableau 11 – Type de ConnectionPoint pour Profibus_DP

Attribut	Valeur				
BrowseName	ConnectionPoint_Profibus_DP				
IsAbstract	False				
Références	NodeClass	BrowseName	DataType	TypeDefinition	ModellingRule
Sous-type du ConnectionPointType défini dans l'IEC 62541-100.					
HasProperty	Variable	Address	Byte	PropertyType	Obligatoire

Le type de ConnectionPoint Profibus_DP doit être décrit par un élément EDD contenu dans un Paquetage FDI associé à l'Appareil de Communication, en mesure de piloter un réseau