BS EN 62769-103-4:2015

BSI Standards Publication

Field Device Integration (FDI)

Part 103-4: Profiles — PROFINET

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National foreword

This British Standard is the UK implementation of EN 62769-103-4:2015. It is identical to IEC 62769-103-4:2015.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: process measurement and control, including fieldbus.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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European foreword

The text of document 65E/355/CDV, future edition 1 of IEC 62769-103-4, prepared by SC 65E "Devices and integration in enterprise systems", of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62769-103-4:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-03-16
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-06-16

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IEC 61158	NOTE	Harmonized in EN 61158 series.
IEC 61784-1	NOTE	Harmonized as EN 61784-1.
IEC 61804-4	NOTE	Harmonized as EN 61804-4 [1)] (not modified).

1) To be published.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 61158-5-10	-	Industrial communication networks - Fieldbus specifications - Part 5-10: Application layer service definition - Type 10 elements	EN 61158-5-10	-
IEC 61784-2	-	Industrial communication networks - Profiles - Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3	EN 61784-2	-
IEC 61804	series	Function blocks (FB) for process control - Electronic device description language (EDDL)	EN 61804	series
IEC 62541-100	2015	OPC unified architecture - Part 100: Device Interface	EN 62541-100	2015
IEC 62769-2	-	Field Device Integration (FDI) - Part 2: FDI Client	EN 62769-2 [2)]	-
IEC 62769-4	-	Field Device Integration (FDI) - Part 4: FDI Packages	EN 62769-4 [2)]	-
IEC 62769-5	-	Field Device Integration (FDI) - Part 5: FDI Information Model	EN 62769-5 [2)]	-
IEC 62769-6	-	Field Device Integration (FDI) - Part 6: FDI Technology Mapping	EN 62769-6 [2)]	-
IEC 62769-7	-	Field Device Integration (FDI) - Part 7: FDI Communication Devices	EN 62769-7 [2)]	-

2) To be published.

CONTENTS

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FIELD DEVICE INTEGRATION (FDI) –

Part 103-4: Profiles – PROFINET

FOREWORD

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

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

CDV	Report on voting
65E/355/CDV	65E/418/RVC

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

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication 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 103-4: Profiles – PROFINET

1 Scope

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

2 Normative references

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

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

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

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

IEC 62541-100:2015, *OPC Unified Architecture – Part 100: OPC UA for Devices*

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

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

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

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

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

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

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

NOTE 4 IEC 62769-6 is technically identical to FDI-2026.

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

NOTE 5 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>

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1 PROFINET is the trade name of the non-profit consortium PROFIBUS & PROFINET International. This information is given for the convenience of users of this technical report 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.

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

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

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

3.2 Abbreviated terms and acronyms

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

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

4 Conventions

4.1 EDDL syntax

This part of IEC 62769 specifies content for the EDD component that is part of FDI Communication Packages. The specification content using EDDL syntax uses the font `Courier New`. The EDDL syntax is used for method signature, variable, data structure and component declarations.

4.2 XML syntax

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

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

4.3 Capitalizations

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

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

- FDI Client, or
- FDI Server.

Some of these terms are compound terms such as:

- Communication Servers, or

- Profile for Package.

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

5 Profile for PROFINET

5.1 General

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

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

5.2 Catalog profile

5.2.1 Protocol support file

5.2.1.1 FDI Device Package

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

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

Table 1 – ProtocolSupportFile for FDI Device Packages

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

5.2.1.2 FDI Communication Package

A GSDML file as specified in ISO 15745-4:2003/AMD1:2006, is an optional attachment for FDI Communication Packages representing PROFINET IO devices. Table 2 specifies the parameters of ProtocolSupportFile for FDI Communication Packages.

Table 2 – ProtocolSupportFile for FDI Communication Packages

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

5.2.2 CommunicationProfile definition

IEC 62769-4 defines a CommunicationProfileT enumeration type for the Catalog XML schema. The PROFINET specific value defined inside this enumeration is "profinet_io".

5.2.3 Profile device

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

Table 3 – Catalog values for profile devices

Element	Attribute	Content
PackageType	–	Profile
Manufacturer	–	Empty
DeviceModel	–	Allowed profile identifier values (PROFILE_ID) are provided by PROFIBUS & PROFINET International (PI). PI provides and maintains 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 referred therein. The string format shall be hexadecimal starting with 0x, e.g. ‘0x3D00’.

5.2.4 Protocol version information

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

Table 4 – Version mapping examples

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

5.3 Associating a Package with a device

5.3.1 Device type identification mapping

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

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

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

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

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

a) The physical Device instance identified at a specific device address is not logically present in the Information model (as Instance): Enable the FDI Host system to find the appropriate FDI Device package according to the device catalogue information.
b) The physical Device instance identified by the device address is logically present in the Information Model (as Instance): Enable the FDI Host system to compare the device type information presented in the scan result (see the identification in Clause A.5 and 5.6.2.7) and the device type specific information of the Instance present in the Information Model.

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

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

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

Table 5 – Device identification information mapping

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

5.3.2 Device type revision mapping

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

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

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

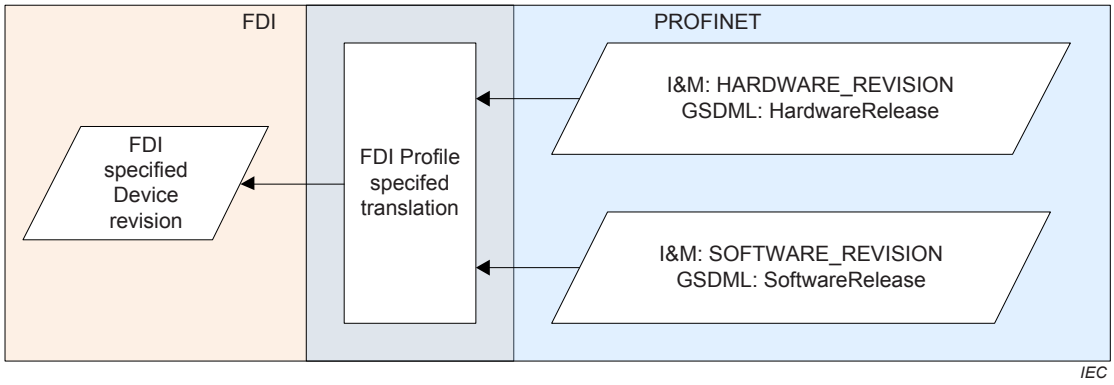

Figure 1 – Version mapping problem

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

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

Hardware related modifications shall be captured in the HARDWARE_REVISION value. Hardware related modifications do not necessarily require always a firmware update. Thus

HARDWARE_REVISION cannot be used to determine compatibility between a device and the FDI Device Package. But if a hardware modification requires firmware modifications both HARDWARE_REVISION and SOFTWARE_REVISION shall be changed.

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

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

5.4 Information Model mapping

5.4.1 ProtocolType definition

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

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

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

Table 6 – Protocol type Profinet_IO

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

5.4.2 DeviceType mapping

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

Table 7 – DeviceType Property mapping

Property	PROFINET Mapping
SerialNumber	SERIAL_NUMBER (see Table 8)
RevisionCounter	REV_COUNTER (see Table 8)
Manufacturer	VendorID (see Table 8, GSDML “Attributes of element DeviceIdentity”)
Model	DeviceID (see Table 8, GSDML “Attributes of element DeviceIdentity”)
DeviceRevision	Not supported
DeviceManual	Not supported
SoftwareRevision	SOFTWARE_REVISION (see Table 8)
HardwareRevision	HARDWARE_REVISION (see Table 8)

5.4.3 FunctionalGroup identification definition

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

Table 8 – PROFINET identification type definition

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

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

5.5 Topology elements

5.5.1 ConnectionPoint definition

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

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

Table 9 – ConnectionPoint type for Profinet_IO

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

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

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

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

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

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

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

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

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

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

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

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

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

5.5.2 Communication Device definition

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

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

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

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

```
COMPONENT Profinet_Communication_Server
{
  LABEL "PROFINET communication server";
  PRODUCT_URI "urn:PROFIBUS International:PROFINET Communication Server";
```

```
  CAN_DELETE TRUE;
  CLASSIFICATION NETWORK_COMPONENT;
  COMPONENT_RELATIONS
  {
    Profinet_Communication_Device_Setup
  }
}

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

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

5.5.3 Communication service provider definition

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

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

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

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

5.5.4 Network definition

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

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

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

5.6 Methods

5.6.1 Methods for FDI Communication Servers

5.6.1.1 General

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

5.6.1.2 Connect

Signature:

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

Table 10 provides the description of the arguments.

Table 10 – Method Connect arguments

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

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

5.6.1.3 Disconnect

Signature:

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

Table 11 provides the description of the arguments.

Table 11 – Method Disconnect arguments

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

5.6.1.4 Transfer

Signature

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

Table 12 provides the description of the arguments.

Table 12 – Method Transfer arguments

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

5.6.1.5 GetPublishedData

This method is not supported by PROFINET IO.

5.6.1.6 SetAddress

Signature

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

Table 13 provides the description of the arguments.

Table 13 – Method SetAddress arguments

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

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

5.6.1.7 Scan

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

5.6.1.8 ResetScan

The method signature specified in IEC 62769-7 applies.

5.6.2 Methods for Gateways

5.6.2.1 General

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

5.6.2.2 Connect

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

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

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

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

Table 13 provides the description of the arguments.

Table 14 – Method Connect arguments

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

5.6.2.3 Disconnect

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

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

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

5.6.2.4 Transfer

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

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

```
  DEFINITION{<Gateway specific implementation>}
}

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

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

Table 15 provides the description of the arguments.

Table 15 – Method Transfer arguments

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

5.6.2.5 GetPublishedData

This method is not supported in PROFINET.

5.6.2.6 SetAddress

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

```
BeginSetAddress(
       char[6]       MAC,
       char[4]       IP,
       DD_String     DNSNAME,
       char[4]       SubnetMask,
       char[4]       Gateway,
       unsigned long ServiceId,
       unsigned long &DelayForNextCall,
       long          &ServiceError)
{
  ACCESS ONLINE;
  DEFINITION{<Gateway specific implementation>}
}

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

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

Table 16 provides the description of the arguments.

Table 16 – Method SetAddress arguments

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

5.6.2.7 Scan

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

```
VARIABLE mDNSName
{
  LABEL "Device station name";
  TYPE STRING(256);
}
```

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

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

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

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

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

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

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

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



LIST Network
{
  TYPE ConnectionPoint;
}
```

5.6.2.8 ScanNext

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

Annex A
(normative)

Topology scan schema

A.1 General

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

A.2 Network

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

The XML schema for a Network element is:

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

A.3 ProfinetNetworkT

The XML schema for a ProfinetNetworkT type is:

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

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

Table A.1 – Elements of ProfinetNetworkT

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

A.4 ProfinetConnectionPointT

The XML schema for a ProfinetConnectionPointT type is:

```
<xs:complexType name="ProfinetConnectionPointT">
   <xs:sequence>
      <xs:element name="Identification"
         type="PI:ProfinetIdentificationT"/>
   </xs:sequence>
   <xs:attribute name="MAC" type="PI:MACT" use="required"/>
```

```
   <xs:attribute name="IPv4" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="DNSName" type="PI:DNSNameT" use="optional"/>
   <xs:attribute name="SubnetMask" type="PI:IPv4T" use="optional"/>
   <xs:attribute name="Gateway" type="PI:IPv4T" use="optional"/>
</xs:complexType>
```

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

Table A.2 – Attributes of ProfinetConnectionPointT

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

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

Table A.3 – Elements of ProfinetConnectionPointT

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

A.5 ProfinetIdentificationT

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

The XML schema for a ProfinetIdentificationT type is:

```
<xs:complexType name="ProfinetIdentificationT">
   <xs:attribute name="VendorID" type="PI:Hex4DigitT" use="required"/>
   <xs:attribute name="DeviceID" type="PI:Hex4DigitT" use="required"/>
</xs:complexType>
```

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

Table A.4 – Attributes of ProfinetIdentificationT

Attribute	Description
VendorID	The attribute value contains the vendor specific part of the device identification number (DeviceIdentNumber) as defined in IEC 61158-5-10. The attribute corresponds to the GSDML defined attribute "VendorID".
DeviceID	The attribute value contains the device specific part of the device identification number (DeviceIdentNumber). The attribute corresponds to the GSDML defined attribute "DeviceID".

A.6 MACT

The XML schema for a MACT type is:

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

A.7 IPv4T

The XML schema for an IPv4T type is:

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

A.8 IPv6T

The XML schema for an IPv6T type is:

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

A.9 DNSNameT

The XML schema for a DNSNameT type is:

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

A.10 Hex4DigitT

The XML schema for a Hex4DigitT type is:

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

Annex B
(normative)

Transfer service parameters

B.1 General

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

B.2 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 receiveData

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

The XML schema for a receiveData element is:

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

B.4 TransferSendDataT

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

The XML schema for a TransferSendDataT type is:

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

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

Table B.1 – Attributes of TransferSendDataT

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

B.5 TransferResultDataT

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

The XML schema for a TransferResultDataT type is:

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

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

Table B.2 – Attributes of TransferResultDataT

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

B.6 OperationT

A simple type that defines possible service operations.

The XML schema for an OperationT enumeration type is:

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

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