IEC TR 62453-52-32

Edition 1.0 2017-06

TECHNICAL REPORT

colour inside

Field device tool (FDT) interface specification – Part 52-32: Communication implementation for common language infrastructure – IEC 61784 CP 3/4, CP 3/5 and CP 3/6

IEC TR 62453-52-32:2017-06(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 52-32: Communication implementation for common language infrastructure – IEC 61784 CP 3/4, CP 3/5 and CP 3/6

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IEC TR 62453-52-32, which is a technical report, has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

Each part of the IEC 62453-52-xy series is intended to be read in conjunction with its corresponding part in the IEC 62453-3xy series. This document corresponds to IEC 62453-303-2.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
65E/440/DTR	65E/514/RVC

Full information on the voting for the approval of this technical report 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.

The list of all parts of the IEC 62453 series, under the general title *Field device tool (FDT) interface specification*, 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

This part of IEC 62453 is an interface specification for developers of Field Device Tool (FDT) components for function control and data access within a client/server architecture. The specification is a result of an analysis and design process to develop standard interfaces to facilitate the development of servers and clients by multiple vendors that need to interoperate seamlessly.

With the integration of fieldbuses into control systems, there are a few other tasks which need to be performed. In addition to fieldbus- and device-specific tools, there is a need to integrate these tools into higher-level system-wide planning or engineering tools. In particular, for use in extensive and heterogeneous control systems, typically in the area of the process industry, the unambiguous definition of engineering interfaces that are easy to use for all those involved is of great importance.

A device-specific software component, called Device Type Manager (DTM), is supplied by the field device manufacturer with its device. The DTM is integrated into engineering tools via the FDT interfaces defined in this specification. The approach to integration is in general open for all kind of fieldbusses and thus meets the requirements for integrating different kinds of devices into heterogeneous control systems.

Figure 1 shows how this part of the IEC 62453-52-xy series is aligned in the structure of the IEC 62453 series.

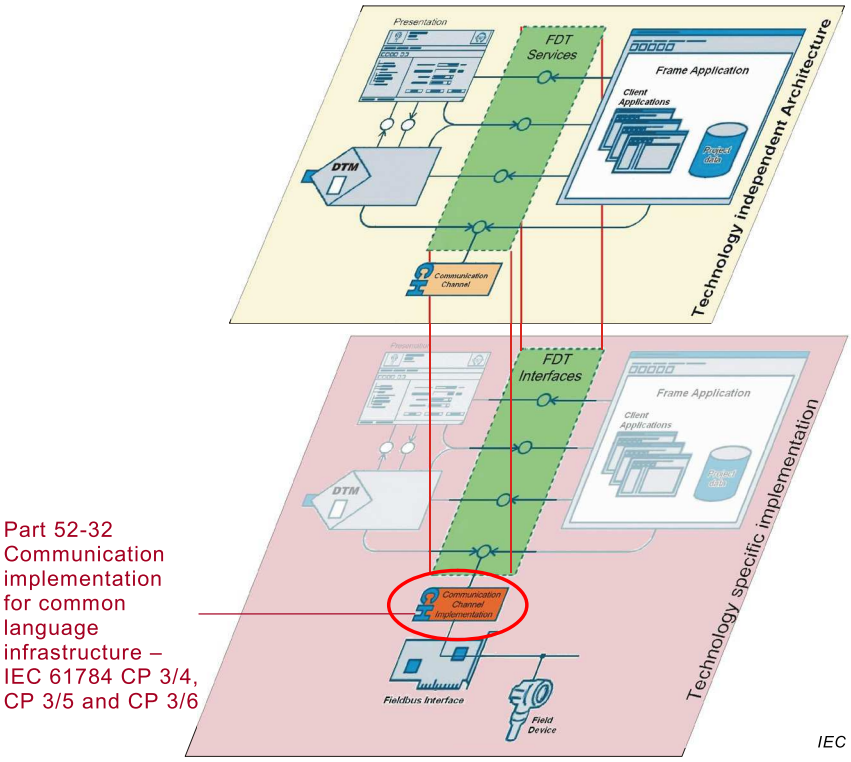

Figure 1 – Part 52-32 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 52-32: Communication implementation for common language infrastructure – IEC 61784 CP 3/4, CP 3/5 and CP 3/6

1 Scope

This part of the IEC 62453-52-xy series, which is a Technical Report, provides information for integrating the PROFINET®[1] technology into the CLI-based implementation of FDT interface specification (IEC TR 62453-42).

This part of IEC 62453 specifies implementation of communication and other services based on IEC 62453-303-2.

This document neither contains the FDT specification nor modifies it.

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 61131-3:2013, *Programmable controllers – Part 3: Programming languages*

IEC 61158-6-10, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61784-1:2014, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 62453-1:2016, *Field device tool (FDT) interface specification – Part 1: Overview and guidance*

IEC 62453-2:2016, *Field device tool (FDT) interface specification – Part 2: Concepts and detailed description*

IEC TR 62453-42: 2016, *Field device tool (FDT) interface specification – Part 42: Object model integration profile – Common language infrastructure*

IEC 62453-303-2:2009, *Field device tool (FDT) interface specification – Part 303-2: Communication profile integration – IEC 61784 CP 3/4, CP 3/5 and CP 3/6*
IEC 62453-303-2:2009/AMD1:2016

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3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62453-1, IEC 62453-2, IEC TR 62453-42 and IEC 62453-303-2 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 Abbreviations

For the purposes of this document, the abbreviations given in IEC 62453-1, IEC 62453-2, IEC 62453-303-2, IEC TR 62453-42, and the following apply.

I&M	Identification and maintenance functions

3.3 Conventions

3.3.1 Datatype names and references to datatypes

The conventions for naming and referencing of datatypes are explained in FDT 2.0 Specification.

3.3.2 Vocabulary for requirements

The following expressions are used when specifying requirements.

Usage of “shall” or “mandatory”	No exceptions allowed.
Usage of “should” or “recommended”	Strong recommendation. It may make sense in special exceptional cases to differ from the described behaviour.
Usage of “can” or “optional”	Function or behaviour may be provided, depending on defined conditions.

3.3.3 Use of UML

Figures in this document are using UML notation as defined in Annex A of IEC 62453-1:2016.

4 Bus Category

PROFINET protocols are identified by the unique identifiers in busCategory attributes as specified in IEC 62453-303-2.

5 Access to instance and device data

5.1 General

Used at interfaces:

– IInstanceData
– IDeviceData

The minimum set of provided data shall be:

– Process values shall be modeled as ProcessData including ranges and scaling, where applicable.
– All network configuration related parameters shall be exposed in NetworkData (see Clause 9).
– All startup parameters of sub modules shall be exposed in NetworkData (see Clause 9).
– It is recommended to expose startup parameters in the IDeviceData and IInstanceData interfaces; exposure of additional parameters is at the device vendor's discretion. Profiles may define a mandatory set of parameters.

5.2 IO signals provided by DTM

A DTM shall provide IO signal information for the device using the IProcessData interface. The IO signals describe datatype and address parameters of process data as detailed in Clause 11.

5.3 Data interfaces

5.3.1 General

Exposure of device parameters is at the vendor's discretion. Profiles may define the mandatory exposure of profile specific parameters. It is recommended to expose at least all startup parameters.

5.3.2 Mapping PROFINET datatypes to FDT datatypes

PROFINET uses datatypes as specified in IEC 61158 for the transmission on the fieldbus. The FDT interfaces IDeviceData and IInstanceData use .NET datatypes, while PLC applications use datatypes as defined in IEC 61131-3. This subclause defines the mapping of parameter datatypes, whereas mapping of process datatypes is defined in Clause 11. The mapping of parameter datatypes is described in Table 1.

Table 1 – Mapping of datatypes

PROFINET datatype	FDT datatype	IEC datatype
Bit	boolean	BOOL
Integer8	int	SINT
Integer16	int	INT
Integer32	int	DINT
Integer64	int	LINT
Unsigned8	byte	USINT
Unsigned16	unsigned	UINT
Unsigned32	unsigned	UDINT
Unsigned64	unsigned	ULINT
Float32	float	REAL
Float64	double	LREAL
Date	date	LWORD
TimeOfDay	dateAndTime	LWORD
TimeOfDayWithoutDateIndication	time	TIME_OF_DAY
TimeDifference	structured	LWORD
TimeOfDayWithoutDateIndication	duration	DWORD
NetworkTime	structured	LWORD
NetworkTimeDifference	structured	LWORD
VisibleString	string	STRING
OctetString	hexString	STRING
Unsigned8Unsigned8	-	WORD
Float32Unsigned8	-	LWORD
Float32Status8	structured	LWORD
F_MessageTrailer4Byte	structured	DWORD
F_MessageTrailer5Byte	structured	LWORD
additional GSDML datatypes		
Bit	boolean	BOOL
BitArea	BinaryBitArray	ARRAY OF BYTE

5.3.3 SemanticInfo

The SemanticInfo provides means to uniquely identify parameters. The usage of SemanticInfo attributes is defined in Table 2.

Table 2 – Usage of SemanticInfo

Attribute	Description of use for PROFINET
SemanticInfo.ReadAddress SemanticInfo.WriteAddress	The value of ReadAddress and WriteAdress is a string conforming to a pattern as follows: Api.Slot.Subslot.Index.ByteOffset.BitOffset.BitLength where Api = API number Slot = Slot number Subslot = Subslot number Index = Index number ByteOffset = start byte within the index BitOffset = start bit within the index BitLength = length in bits All values are unsigned integers. NOTE Profiles may define additional address formats.
SemanticInfo.ApplicationDomain	The value of ApplicationDomain is as follows: FDT PROFINET FDT PROFIDRIVE NOTE Profiles may define additional ApplicationDomain values.
SemanticInfo.SemanticId	The value of SemanticId is vendor specific. Profiles may define a distinct set of mandatory SemanticId values.

6 Protocol specific behavior

6.1 PROFINET device model

The PROFINET device model is captured in a hierarchical structure of ProtocolNetworkData class (see Figure 2). Further details on attributes and methods are provided in Clause 9.

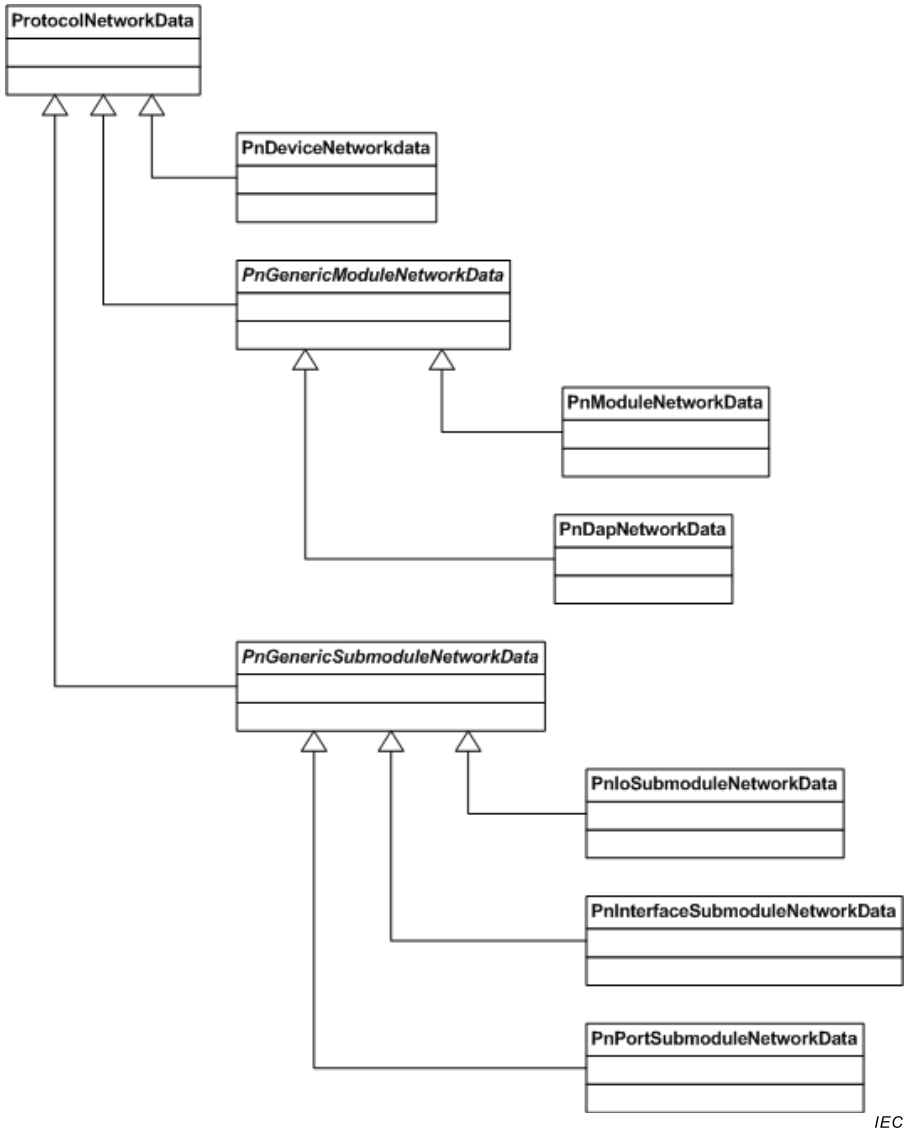


Figure 2 – PROFINET Device Model

6.2 Configuration and parameterization of PROFINET devices

In order to enable a PROFINET Communication DTM to configure and parameterize a PROFINET Network, all type data usually included in a vendor specific GSDML file, are provided in NetworkData (see Clause 9 for further details). The Communication DTM is responsible for calculating or querying any instance data needed for network configuration.

6.3 PROFINET – related information of a Device DTM

The information used by a PROFINET controller to set up the PROFINET network properly and allow cyclic communication between control system and PROFINET devices is provided by a DTM in:

- PROFINET network data
- Process data items.

A DTM of a PROFINET device shall deliver these parts of PROFINET related information to get integrated into an FDT-based engineering system. Below (see Clauses 8, 9 and 11), a more detailed description is given on how to generate and how to provide this information.

This specification makes no assumptions whether a modular PROFINET device is modeled in a Device DTM, Composite DTM or Gateway DTM. All types of DTMs have to provide all mandatory information defined in the following chapters.

6.4 Remarks on FDT 1.2 / 2 Compatibility

A variety of features and capabilities have been included in PROFINET since the release of the FDT 1.2 Annex for PROFINET. In order to utilize these additional features, a pure FDT 2.0 environment is required. For mixed topologies, Table 5 provides information on which data is available with FDT 1.2 DTMs and consequently, is available in a mixed topology after transformation. Conversely, only this subset is available when using FDT 2.0 DTMs (as child DTMs) below a FDT 1.2 DTM (as parent DTM) in a mixed topology.

7 Protocol specific usage of general FDT datatypes

The FDT2.0 Specification already defines a set of datatypes that can be used to identify a device and to provide device information. This clause describes how these datatypes are used with PROFINET.

Table 3 – Usage of general datatypes

Attribute	Description for use in PROFINET
ProtocolId	See Clause 4
PhysicalLayer	See Clause 4
ApplicationDomian/ SemanticId	See 5.3.3
Address	See Clause 8
ManufacturerId	See ‘IM0.IM_Vendor_ID‘ and ‘DCP.DeviceVendorValue’ given in 12.3
DeviceTypeId	See ‘DCP_DeviceIdentNumber’ given in 12.3
HardwareRevision	See ‘IM_Hardware_Revision’ given in 12.3
SoftwareRevision	See ‘IM_Software_Revision’ given in 12.3
ProtocolIdentificationProfile	Identifies the protocol specific profile that was used for device identification. It contains one of the values "DCP" or "IM".
Tag	See ‘DeviceName’ in 12.2
Serialnumber	See 12.2
ProtocolSpecificProperties	See ‘DCP_ManufacturerSpecificString‘, ‘IM_OrderID’, ‘IM_Profile_ID’, ‘IM_Profile_Specific_Type’ ‘DCP_DeviceRoleDetail’, ‘ConfiguredState’ in 12.3

8 Protocol specific common datatype: PnDeviceAddress

The only protocol-specific common datatype is PnDeviceAddress. The protocol specific device address relates to network management and communication. See Figure 3 and Table 4.

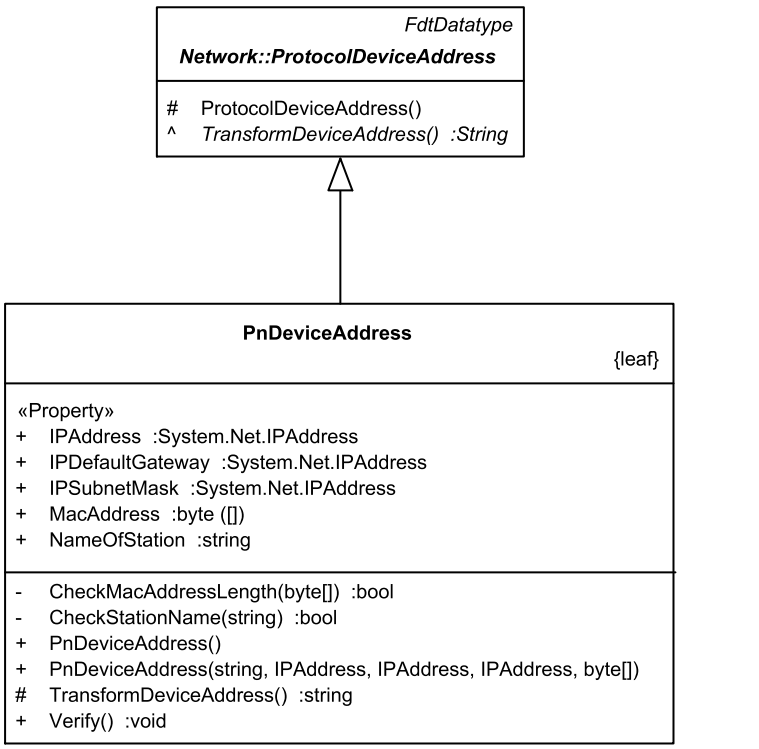


Figure 3 – PROFINET Device Address

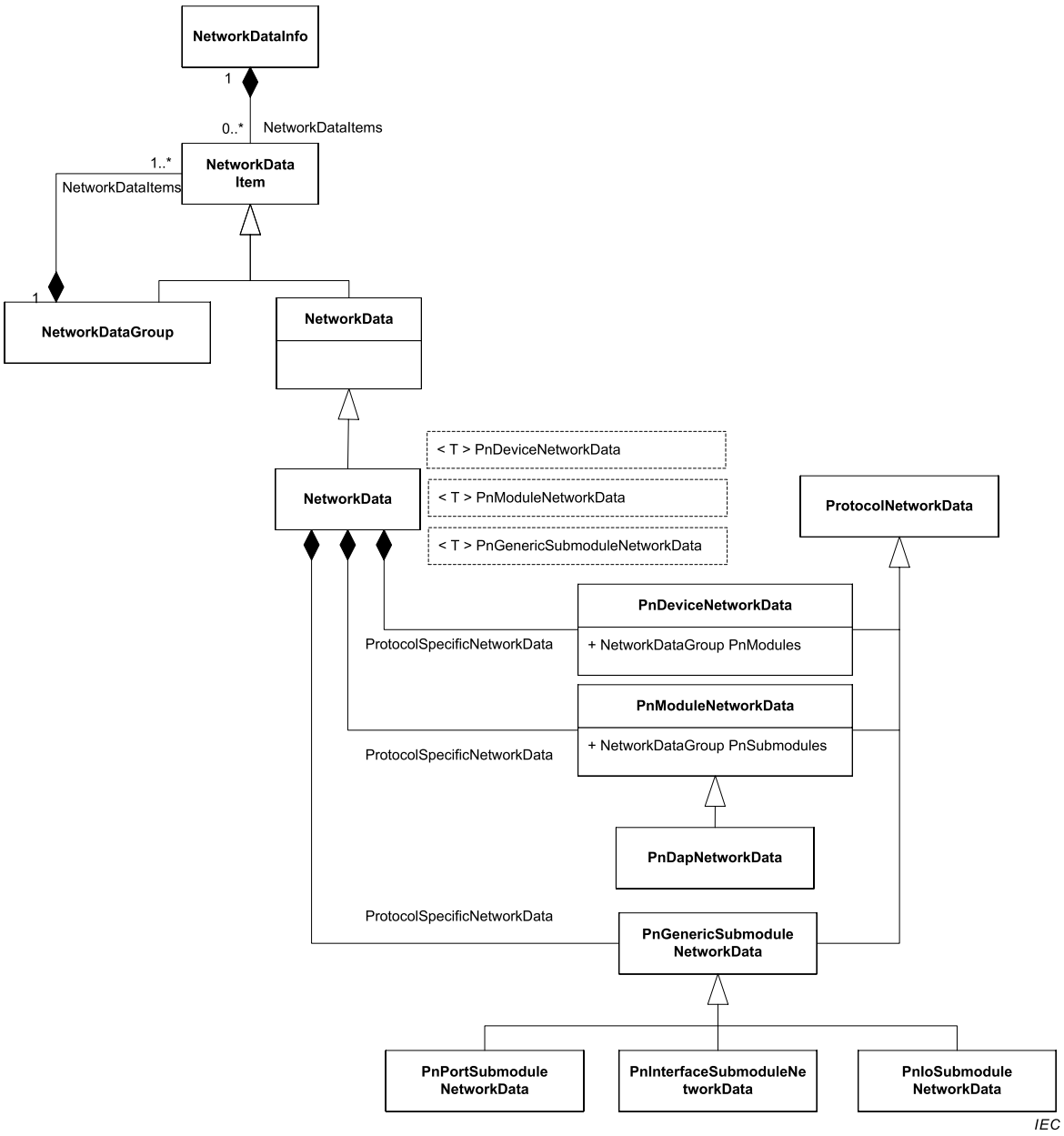
Table 4 – PnDeviceAddress

Property	Usage	Multiplicity	Description
IPAddress	M	[1..1]	The attribute contains the IP address that is assigned to the device. The IP address is a secondary address. The default value is System.Net.IPAddress(new byte[] { 0, 0, 0, 0 }).
IPDefaultGateway	M	[1..1]	The attribute contains the default gateway address. The default value is null.
IPSubnetMask	M	[1..1]	The attribute contains the subnet mask. The default value is System.Net.IPAddress(new byte[] { 255, 255, 255, 255 }).
MacAddress	M	[1..1]	The attribute contains the MAC address of the device. The MAC address is a secondary address. The default Value is new byte[6].
NameOfStation	M	[1..1]	The station name is the primary address. The default value is an empty string.

9 Network management

9.1 General

The data needed for management of the network is exposed by the Device DTM in the INetworkData interface. See Figure 4.



Used in:

INetworkData::GetNetworkDataInfo()

Figure 4 – PROFINET Network Data

The datatype PnDeviceAddress is used for defining the network address of a device.

The protocol specific datatypes are based on definitions given in the IEC 61784 and IEC 61158 specifications. Furthermore, they contain additional information about the device that is needed by systems to configure PROFINET links and to establish communication between the PROFINET Controller and the PROFINET devices.

9.2 Configuration

The configuration of the device itself is done with the aid of the DTM's GUI. Downloading the configuration into the PROFINET device is performed via the PROFINET controller. To do that and in order to set up the bus communication, the PROFINET controller needs information from the DTM. Table 5 describes the properties of PROFINET specific network data.

Table 5 – PROFINET Network Data

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
PnDeviceNetworkData	Class			
PnModules	NetworkDataGroup	The related modules of the Device.		M
PnRole	Enumeration	Specifies the role for shared Device.		M
ObjectUUID_LocalIndex	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
DeviceID	Uint16	//ISO15745Profile/ProfileBody/DeviceIdentity		M
DeviceName	string	Address information according to the PROFINET specification.		M
VendorID	UInt16	//ISO15745Profile/ProfileBody/DeviceIdentity		M
InfoText	string	Additional textual information. Shall only be set by DTM.	O	M
VendorName	string	//ISO15745Profile/ProfileBody/DeviceIdentity/VendorName		M
ArType	UInt16	ARType according to the PROFINET specification. Shall only be set by Parent.	M	M
ArUUID	Guid	ARUUID according to the PROFINET specification. Shall only be set by Parent.	M	M
ArProperties	UInt32	ARProperties according to the PROFINET specification. Shall only be set by Parent.	M	M
DeviceTypeInformation	Document	The attribute contains the path to the device description file. For Profinet devices it is mandatory to provide this attribute. Only a parent developed according to the Profinet Annex can handle GSDML information.	O	M
PnModuleNetworkData	Class			
PnSubmodules	NetworkDataGroup	Contains the elements for addressing a IO Device.		M
SlotNumber	UInt16	The slot address that is used by the module. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
ModuleIdentNumber	UInt32	The ModuleIdentNumber according to the PROFINET specification. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
Name	string	Name for the enclosing module. Shall only be set by DTM.	M	M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
Descriptor	string	Description for the enclosing module. Shall only be set by DTM.	O	M
PnDapNetworkData	Class			
PnDeviceAddress	Class	Contains the elements for addressing a PROFINET Device.		M
MaxInputLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MaxOutputLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MinDeviceInterval	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
PNIO_Version	string	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
AddressAssignment	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
CiR_Supported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
DeviceAccessSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
IOXS_Required	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
LLDP_NoD_Supported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
MaxApplicationDataLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MaxApplicationInputLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MaxApplicationOutputLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MaxDataLength	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/IOConfigData		M
MaxSupportedRecordSize	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
MultipleWriteSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
NameOfStationNotTransferable	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
ParameterizationSpeedupSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
PowerOnToCommReady	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
RemoteApplicationTimeout	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem		M
PnGenericSubmodule NetworkData	Class			
SubslotNumber	UInt32	The subslot address that is used by the submodule. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
Writeable_IM_Records	Array of UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
SubModuleIdentNumber	UInt32	The SubmoduleIdentNumber according to the PROFINET specification. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
Name	string	Name for the enclosing submodule. Shall only be set by DTM.		M
Descriptor	string	Description for the enclosing submodule. Shall only be set by DTM.		M
RecordParamData	Class	Encapsulates the address of the desired record data object, the binary data that will be written to the submodule during startup or connect and the transfer sequence to order the elements. The record data implicitly contain the record data length. Shall only be set by DTM.	M	M
PnPortSubmodule NetworkData	Class			
CheckMAUTypeSupported	Bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
FiberOpticTypes	FDTList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
IsDefaultRingport	Bool			M
LinkStateDiagnosisCapability	Enumeration			M
MAUTypes	FdtList			M
MaxPortRxDelay	UInt16			M
MaxPortTxDelay	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
ParameterizationDisallowed	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
PortDeactivationSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
PowerBudgetControlSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
ShortPreamble100MBitSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/PortSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/PortSubmoduleItem		M
PnInterfaceSubmodule NetworkData	Class			M
RT_Class3MaxBridgeDelay	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
AlarmCrType	UInt16	AlarmCRType according to the PROFINET specification. Shall only be set by Parent.	M	M
AlarmCRProperties	UInt32	AlarmCRProperties according to the PROFINET specification. Shall only be set by Parent.	M	M
RTATimeoutFactor	UInt16	RTATimeoutFactor according to the PROFINET specification. Shall only be set by Parent.	M	M
RTARetries	UInt16	RTARetries according to the PROFINET specification. Shall only be set by Parent.	M	M
LocalAlarmReference	UInt16	LocalAlarmReference according to the PROFINET specification. Shall only be set by Parent.	M	M
MaxAlarmDataLength	UInt16	MaxAlarmDataLength according to the PROFINET specification. Shall only be set by Parent.	M	M
ARTimingProperty WatchdogFactor	UInt16	IEC 61158-6-10, 5.2.4.66		M
ARTimingPropertyDataHoldFactor	UInt16	IEC 61158-6-10, 5.2.4.66		M
ARTimingPropertyReductionRatio	UInt16	IEC 61158-6-10, 5.2.4.63		M
ARTimingProperty SendclockFactor	UInt16	IEC 61158-6-10, 5.2.4.62		M
SupportedMibs	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
SupportedProtocols	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
SynchronisationMaxLocalJitter	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/SynchronisationMode		M
PTP_BoundarySupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
ARNumberOfAdditionalOutputCR	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
ARNumberOfAR	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
ARNumberOf MulticastConsumerCR	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
ARPullModuleAlarmSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
ARRT_Class3TimingProperties PreferredSendClock	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/RT_Class3TimingProperties		M
ARRT_Class3TimingProperties ReductionRatios	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/RT_Class3TimingProperties		M
ARRT_Class3TimingProperties SendClock	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/RT_Class3TimingProperties		M
ARStartupMode	Enumeration	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
ARTimingProperty PreferredSendClock	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/TimingProperties		M
ARTimingProperty ReductionRatios	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/TimingProperties		M
ARTimingProperty ReductionRatiosNonPow2	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/TimingProperties		M
ARTimingProperty ReductionRatiosPow2	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/TimingProperties		M
ARTimingProperty SendClockFactors	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations/TimingProperties		M
DCP_BoundarySupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
DCP_FlashOnceSignalUnit	string	//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/General/ DCP_FlashOnceSignalUnit		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
DCP_HelloSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
ARNumberOfAdditionalMulticastProviderCR	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
DelayMeasurementSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
IsochroneModeInRT_Classes	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
MediaRedundancyAdditionalProtocolsSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/MediaRedundancy		M
MediaRedundancyMRPD_Supported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/MediaRedundancy		M
MediaRedundancyMRT_Supported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/MediaRedundancy		M
MediaRedundancySupportedRole	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/MediaRedundancy		M
MulticastBoundarySupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
NetworkComponentDiagnosisSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
ParameterizationDisallowed	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
RT_Class3AlignDFP_Subframes	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3ForwardingMode	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3FragmentationType	Enumeration	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
RT_Class3MaxDFP_Feed	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MaxDFP_Frames	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MaxNumberIR_FrameData	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MaxRangeIR_FrameID	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MaxRedPeriodLength	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MaxBridgeDelayFFW	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3MinFSO	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
RT_Class3StartupMode	Enumeration	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/RT_Class3Properties		M
SupportedRT_Classes	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem		M
SynchronisationT_PLL_MAX	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/SynchronisationMode		M
SynchronisationSupported SyncProtocols	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/SynchronisationMode		M
SynchronisationSupportedRole	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/SynchronisationMode		M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0
SynchronisationPeerToPeerJitter	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/SynchronisationMode		M
ARNumberOfAdditionalInputCR	UInt16	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/SystemDefinedSubmoduleList/InterfaceSubmoduleItem/ApplicationRelations		M
PnIoSubmoduleNetworkData	Class			
SubmodulePropertiesType	Enumeration	Allowed values are: Input, Output, InputAndOutput Values and meaning according PROFINET specification – SubmoduleProperties.Type. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
SubmodulePropertiesSharedInput	Enumeration	Allowed values are: IOController, IOControllerShared. Values and meaning according PROFINET specification – SubmoduleProperties.SharedInput Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
SubmodulePropertiesReduceInputSubmoduleDataLength	Enumeration	Allowed values are: Expected, Zero. Values and meaning according PROFINET specification – SubmoduleProperties.ReduceInputSubmoduleDataLength. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
SubmodulePropertiesReduceOutputSubmoduleDataLength	Enumeration	Allowed values are: Expected, Zero. Values and meaning according PROFINET specification – SubmoduleProperties.ReduceOutputSubmoduleDataLength. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
SubmodulePropertiesDiscardIOXS	Enumeration	Allowed values are: Expected, Zero. Values and meaning according PROFINET specification - SubmoduleProperties.DiscardIOXS. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
API	UInt32	The API according to the PROFINET specification. Shall be set by DTM during configuration. Can be set by Parent during topology scan.	M	M
InputDataConsistency	Enumeration	The consistency of the input data. Shall only be set by DTM during configuration.	O	M
InputDataList	FdtList	List of input data provided by a submodule. The list refers to the corresponding FDT channel objects.	O	M
OutputDataConsistency	Enumeration	The consistency of the output data. Shall only be set by DTM during configuration.	O	M
OutputDataList	FdtList	List of output data provided by a submodule. The list refers to the corresponding FDT channel objects.	O	M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0

IsochroneModeRequired	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

IsochroneModeT_DC_Base	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

IsochroneModeT_DC_Max	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

IsochroneModeT_DC_Min	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

IsochroneModeT_IO_Base	UInt64	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

Name	Datatype	Description	FDT 1.2.1	FDT 2.0

IsochroneModeT_IO_InputMin	UInt64	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

IsochroneModeT_IO_OutputMin	UInt64	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/IsochroneMode
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/IsochroneMode
				M

PROFIenergy	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem/PROFIenergy
		//ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem/PROFIenergy
		//ISO15745Profile/ProfileBody/ApplicationProcess/SubmoduleList/SubmoduleItem/PROFIenergy
				M

PROFIsafeSupported	bool	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem		M
SupportedSubstitutionModes	FdtList	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem		M
Max_iParameterSize	UInt32	//ISO15745Profile/ProfileBody/ApplicationProcess/DeviceAccessPointList/DeviceAccessPointItem/VirtualSubmoduleList/VirtualSubmoduleItem //ISO15745Profile/ProfileBody/ApplicationProcess/ModuleList/ModuleItem/VirtualSubmoduleList/VirtualSubmoduleItem		M

9.3 Process Data Items

For a detailed description about Process Data Items, please refer to Clause 11.

9.4 Parameterization

For a detailed description about parameterization, please refer to 6.2.

10 Communication datatypes

10.1 General

The datatypes described in this clause are used at following services:

– ConnectRequest and ConnectResponse
– DisconnectRequest and DisconnectResponse
– TransactionRequest and TransactionResponse
– SubscribeRequest and SubscribeResponse
– UnsubscribeRequest and UnsubscribeResponse
– AbortMessage

10.2 ConnectRequest and ConnectResponse Services

10.2.1 PnConnectRequest Service

The class PnConnectRequest describes the communication request according to the IEC 61784 CPF 3/3 specification to establish a communication link to a certain device (see Figure 5 and Table 6).

It encapsulates the necessary information to establish a connection. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

The client can indicate the intended usage of the communication link through the field ReadOnly. If the client specifies this field, the client can only use Read Request (in the case of ReadOnly = true) or Read and Write Request (in case of ReadOnly = false). On the other side, the server can use this information to perform optimizations, e.g. use of an implicit AR instead of an explicit AR (in the case of ReadOnly = true).

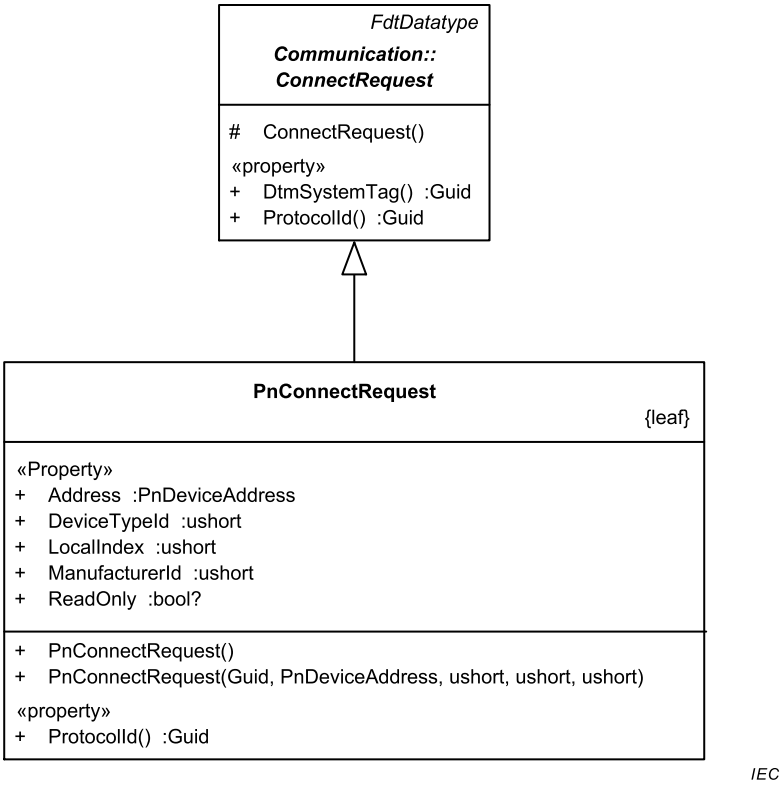


Figure 5 – PnConnectRequest

Table 6 – PnConnectRequest datatype

Property	Usage	Multiplicity	Description
Address	M	[1..1]	See Clause 8
DeviceTypeId	M	[1..1]	Device identifier
LocalIndex	M	[1..1]	Local Index, Instance identifier
ManufacturerId	M	[1..1]	Manufacturer identifier
ProtocolId	M	[1..1]	Protocol Identifier
ReadOnly	O	[0..1]	Only read support required on this connection. The CommunicationChannel can use this information for optimized connection management e.g. use implicit AR.

10.2.2 PnConnectResponse Service

The class PnConnectResponse describes the communication response according to the IEC 61784 CPF 3/3 specification to establish a communication link to a certain device (see Figure 6 and Table 7).

It encapsulates the response data when establishing a connection. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

The field CommunicationReference in this class contains the identifier of the established logical connection link that can be used for later communication requests.

The server may return additional information within the optional fields AddData1 and AddData2 from the underlying PROFINET response.

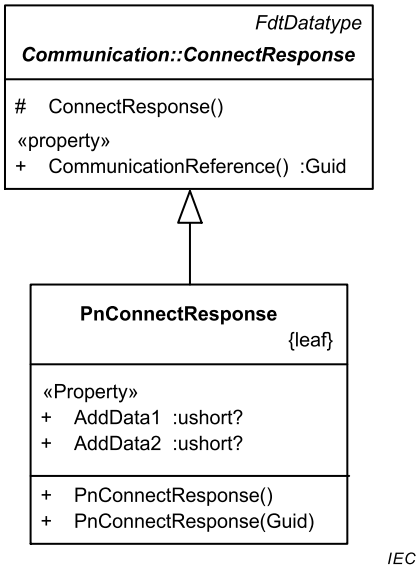


Figure 6 – PnConnectResponse

Table 7 – PnConnectResponse datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls
AddData1	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
AddData2	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification

10.3 DisconnectRequest and DisconnectResponse Services

10.3.1 PnDisconnectRequest Service

The class PnDisconnectRequest describes the communication request according to the IEC 61784 CPF 3/3 specification to release an existing communication link to a certain device (see Figure 7 and Table 8).

It encapsulates the necessary information to release a connection. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

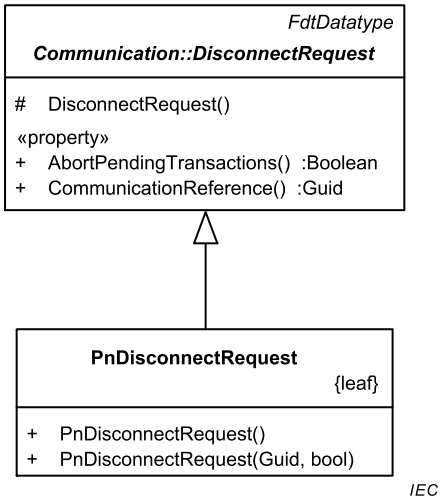


Figure 7 – PnDisconnectRequest

Table 8 – PnDisonnectRequest datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.
AbortPendingTransactions	M	[1..1]	The flag indicates whether the communication component should handle or abort pending transaction.

10.3.2 PnDisconnectResponse Service

The class PnDisconnectResponse describes the communication response according to the IEC 61784 CPF 3/3 specification to release a communication link to a certain device (see Figure 8 and Table 9).

It encapsulates the response data when releasing a connection. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

The server may return additional information within the optional fields AddData1 and AddData2 from the underlying PROFINET response.

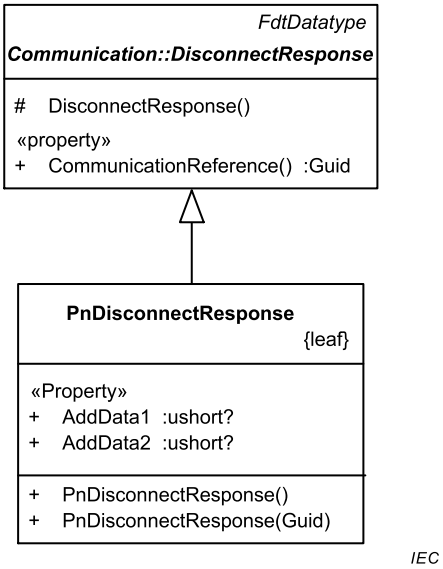


Figure 8 – PnDisconnectResponse

Table 9 – PnDisconnectResponse datatype

Property	Usage	Multiplicity	Description
AddData1	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
AddData2	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification

10.4 TransactionRequest and TransactionResponse Services

10.4.1 PnReadRequest Service

The class PnReadRequest describes the communication request according to the IEC 61784 CPF 3/3 specification to read information from a device (see Figure 9 and Table 10).

It encapsulates the necessary information for reading information. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

Using the optional field Length, the client can limit the amount of data to read. The optional field Id that is derived from the base class is mandatory for the protocol PROFINET. The constructor fills this field with an unique value. The value of the field is necessary in mixed topology scenarios for compatibility reasons. It identifies a request and the client utilizes it for cancelling a request using PnCancelRequest.

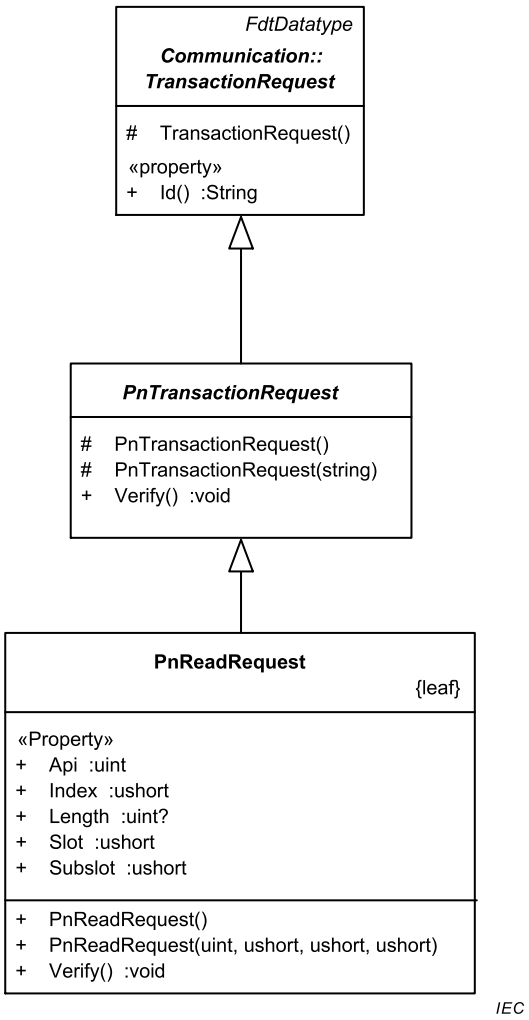


Figure 9 – PnReadRequest

Table 10 – PnReadRequest datatype

Property	Usage	Multiplicity	Description
Api	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Index	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Slot	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Subslot	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Length	O	[0..1]	Maximum length of communication data in read request
Id	O	[0..1]	Unique identifier of the transaction; The constructor provides a unique initial value.

10.4.2 PnReadResponse Service

The class PnReadResponse describes the communication response according to the IEC 61784 CPF 3/3 specification to read information from a device (see Figure 10 and Table 11).

It encapsulates the necessary information for reading information. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

If the service was executed successfully, the field CommunicationData provides the device data.

Otherwise, the field CommunicationData shall be set to null and the communication component shall provide error information using the fields ErrrorInformation or ResponseError.

The server may return additional information within the optional fields AddData1 and AddData2 from the underlying PROFINET response.

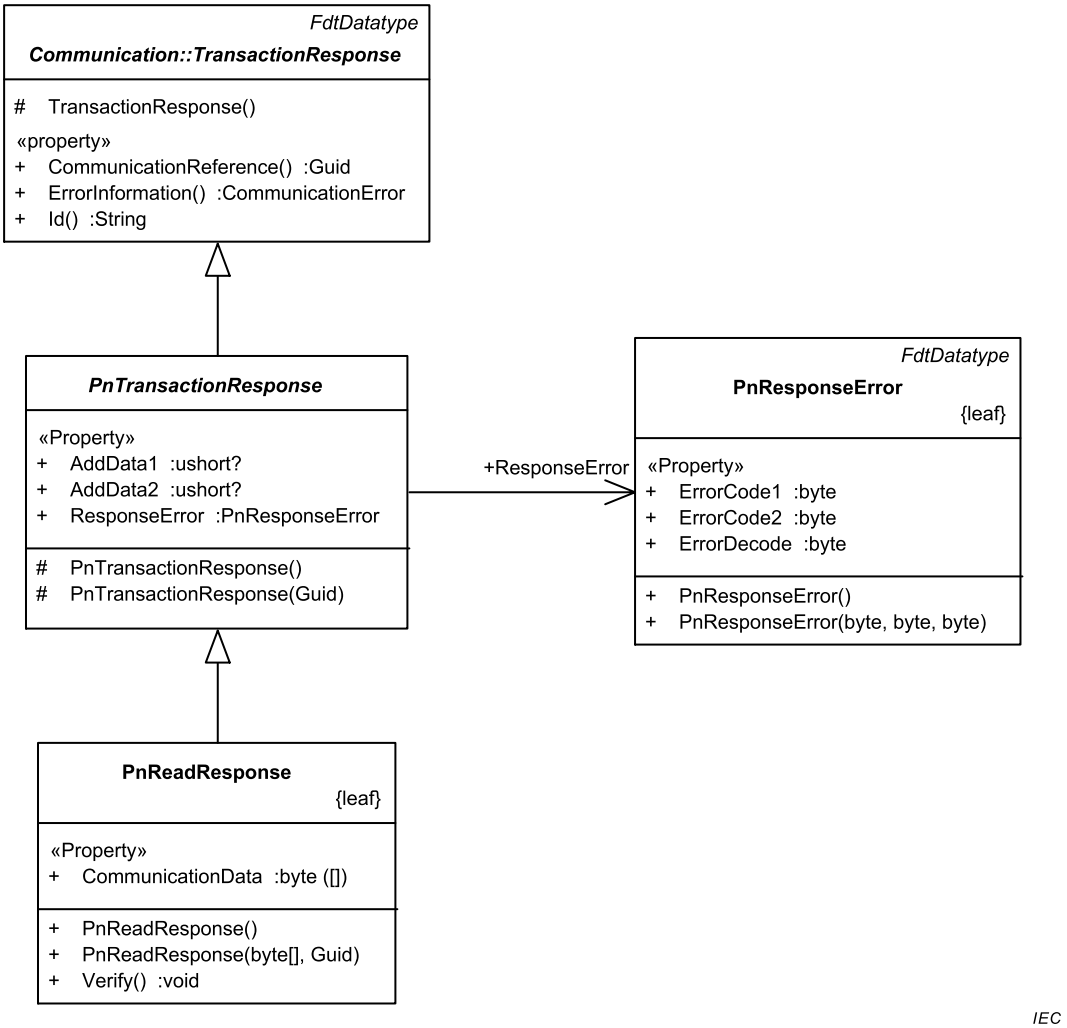


Figure 10 – PnReadResponse

Table 11 – PnReadResponse datatype

Property	Usage	Multiplicity	Description
CommunicationData	M	[1..1]	The communication data as byte array
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.
ErrorInformation	O	[0..1]	See [2][2]
Id	O	[0..1]	Unique identifier of the transaction; The value shall match to the corresponding request.
AddData1	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
AddData2	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
ResponseError	O	[0..1]	See 10.8

10.4.3 PnWriteRequest Service

The class PnWriteRequest describes the communication request according to the IEC 61784 CPF 3/3 specification to write information to a device (see Figure 11 and Table 12).

It encapsulates the necessary information for writing information. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

The optional field Id that is derived from the base class is mandatory for the protocol PROFINET. The constructor fills this field with a unique value. The value of the field is necessary in mixed topology scenarios for compatibility reasons. It identifies a request and the client utilizes it for cancelling a request using PnCancelRequest.

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2 Figures in square brackets refer to the bibliography.

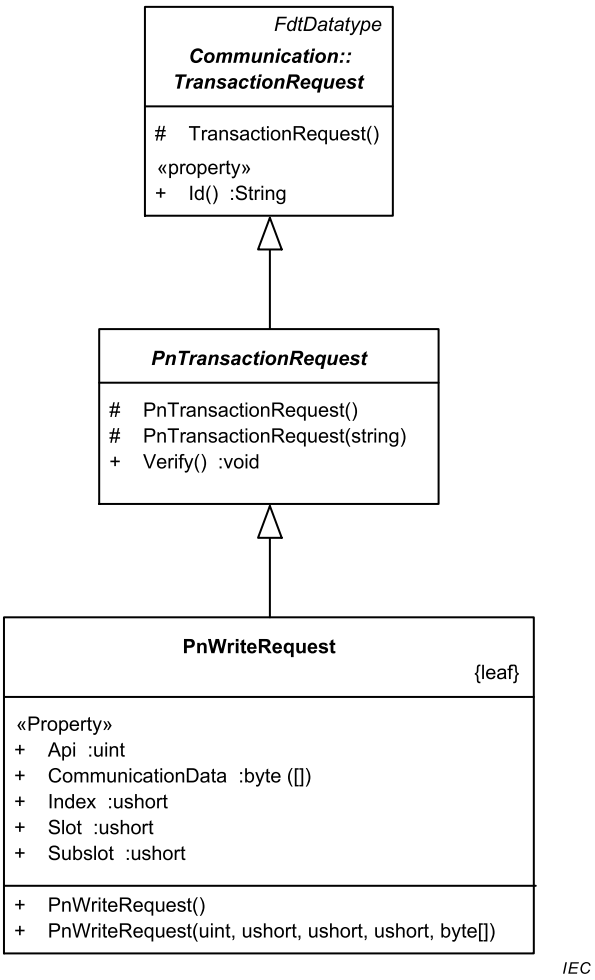


Figure 11 – PnWriteRequest

Table 12 – PnWriteRequest datatype

Property	Usage	Multiplicity	Description
Api	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
CommunicationData	M	[1..1]	The communication data as byte array
Index	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Slot	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Subslot	M	[1..1]	Address information according to the IEC 61784 CPF 3/3
Id	O	[0..1]	Unique identifier of the transaction. The constructor provides a unique initial value.

10.4.4 PnWriteResponse Service

The class PnWriteResponse describes the communication response according to the IEC 61784 CPF 3/3 specification to write information to a device (see Figure 12 and Table 13).

It encapsulates the necessary information for writing information. The default constructor for this class creates an empty instance. When using this constructor, the caller is responsible for providing the values of the required fields of this class.

Additionally, the class provides a custom constructor. This overload of the constructor accepts values for all mandatory fields as arguments.

If the execution of the service fails, the communication component shall provide error information using the fields ErrrorInformation or ResponseError.

The server may return additional information within the optional fields AddData1 and AddData2 from the underlying PROFINET response.

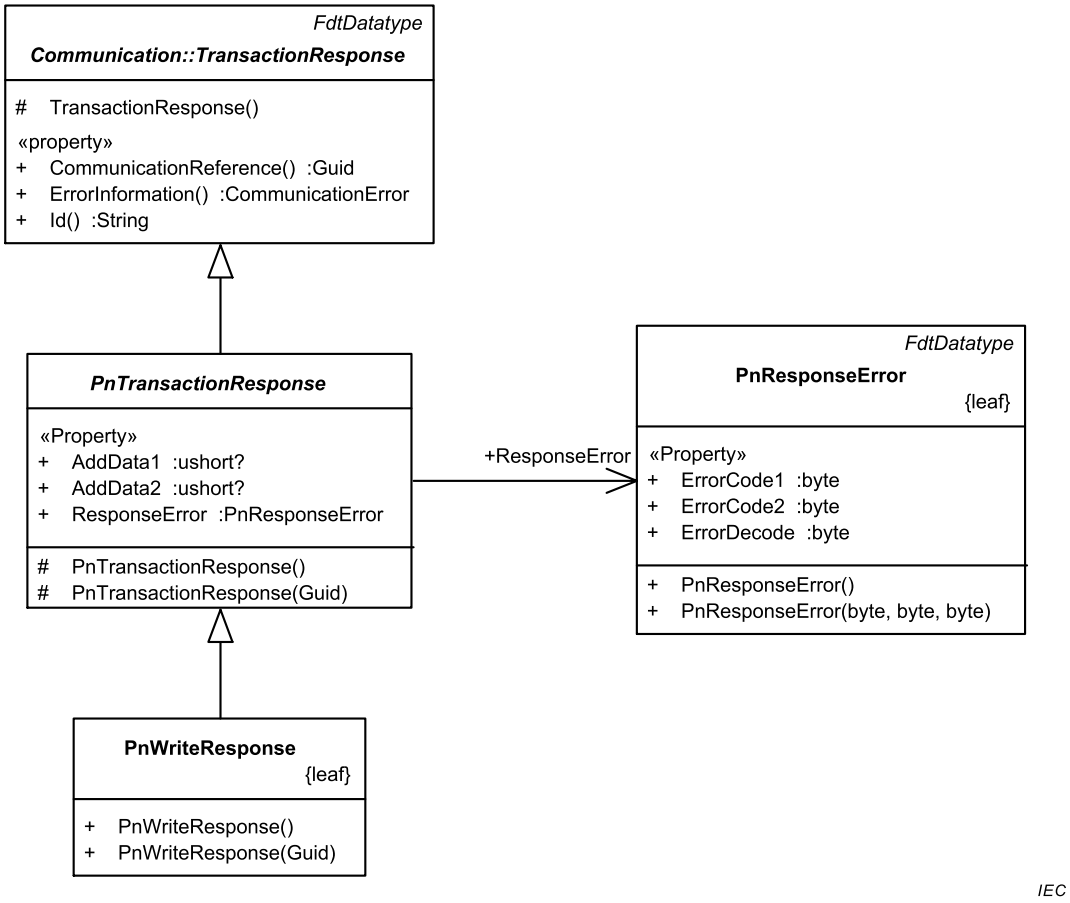


Figure 12 – PnWriteResponse

Table 13 – PnWriteResponse datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.
AddData1	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
AddData2	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
ErrorInformation	O	[0..1]	See [2]
Id	O	[0..1]	Unique identifier of the transaction; The value shall match to the corresponding request.
ResponseError	O	[0..1]	See 10.8

10.4.5 PnCancelRequest Service

The class PnCancelRequest describes a specific transaction request to cancel a pending transaction. The pending transaction that should be cancelled is identified by the field Id (see Figure 13 and Table 14).

The class is defined for compatibility reasons and should be used only in mixed topology scenarios that combine DTMs according to FDT Specification 1.2.1 and FDT Specification 2.0. The communication component shall implement the same behavior to handle this request as method ICommunication::CancelCommunicationRequest().

Otherwise, in a topology that contains only DTMs according to FDT Specification 2.0, the client shall use method ICommunication::CancelCommunicationRequest().

If there is no pending transaction having the provided Id, the communication component shall generate a CommunicationError instead of a response of type PnCancelResponse. The field ErrorCode of CommunicationError object contains CommunicationErrors.NoPendingRequest.

No transaction response can be expected for the previous pending request.

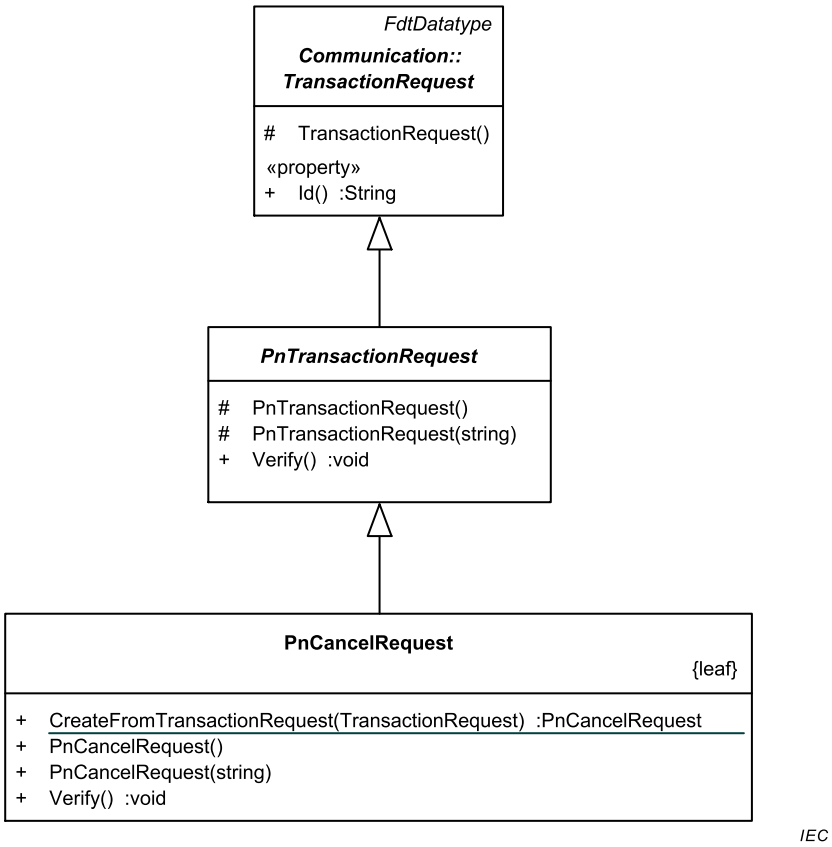


Figure 13 – PnCancelRequest

Table 14 – PnCancelRequest datatype

Property	Usage	Multiplicity	Description
Id	O	[0..1]	Id of the pending transaction

10.4.6 PnCancelResponse Service

The class PnCancelResponse was introduced for compatibility reasons (see Figure 14 and Table 15).

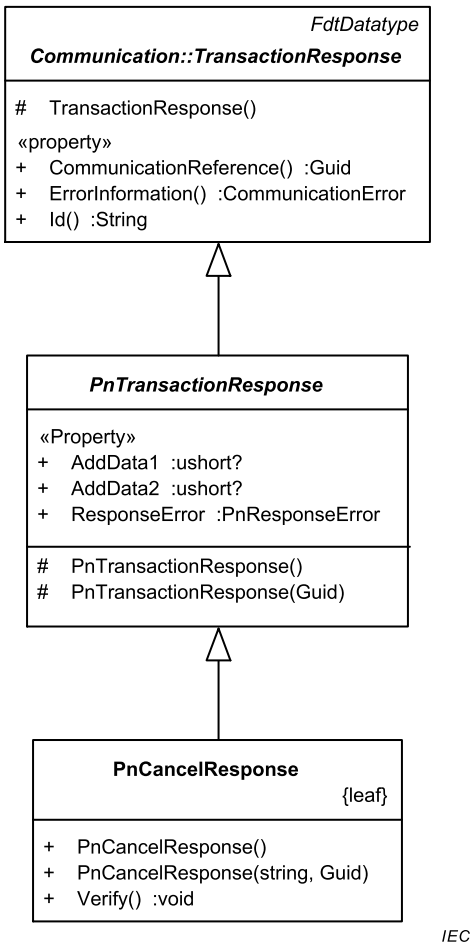


Figure 14 – PnCancelResponse

Table 15 – PnCancelResponse datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.
AddData1	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
AddData2	O	[0..1]	Address information according to the IEC 61784 CPF 3/3 specification
ErrorInformation	O	[0..1]	See [2]
Id	O	[0..1]	Unique identifier of the transaction; The value shall match to the corresponding request.
ResponseError	O	[0..1]	See 10.8

10.5 SubscribeRequest and SubscribeResponse Service

10.5.1 PnSubscribeRequest

The class PnSubscribeRequest describes a request in order to subscribe to device-initiated data transfer. This specification provides a generic definition (see Figure 15 and Table 16).

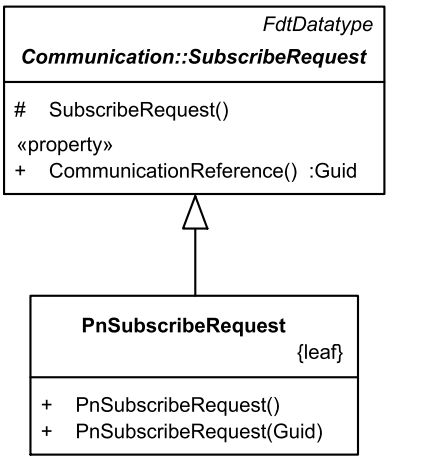


Figure 15 – PnSubscribeRequest

Table 16 – PnSubscribeRequest datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.

10.5.2 PnSubscribeResponse

The class PnSubscribeResponse describes a response when subscribing to device-initiated data transfer. This specification provides a generic definition (see Figure 16 and Table 17).

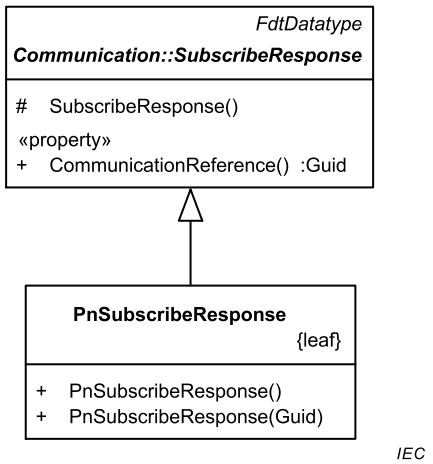


Figure 16 – PnSubscribeResponse

Table 17 – PnSubscribeResponse datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.

10.6 UnsubscribeRequest and UnsubscribeResponse Service

10.6.1 PnUnsubscribeRequest Service

The class PnUnsubscribeRequest describes a request in order to unsubscribe from device-initiated data transfer. This specification provides a generic definition (see Figure 17 and Table 18).

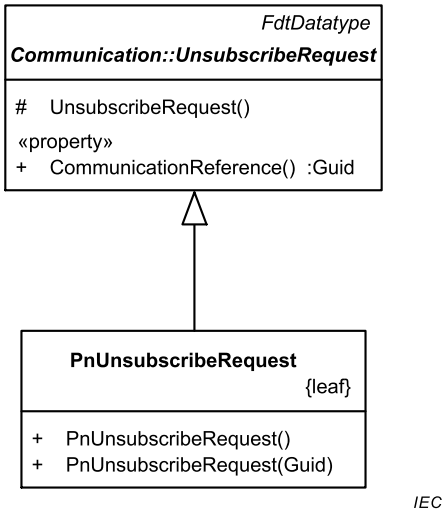


Figure 17 – PnUnsubscribeRequest

Table 18 – PnUnsubscribeRequest datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.

10.6.2 PnUnsubscribeResponse Service

The class PnUnsubscribeResponse describes a response when unsubscribing from device-initiated data transfer. This specification provides a generic definition (see Figure 18 and Table 19).

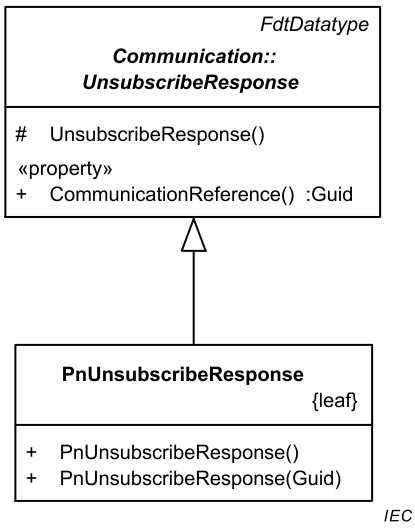


Figure 18 – PnUnsubscribeResponse

Table 19 – PnUnsubscribeResponse datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.

10.7 AbortMessage Service

The class PnAbortMessage describes the abort. This message shall be sent when the communication component recognizes the loss of the physical connection (see Figure 19 and Table 20).

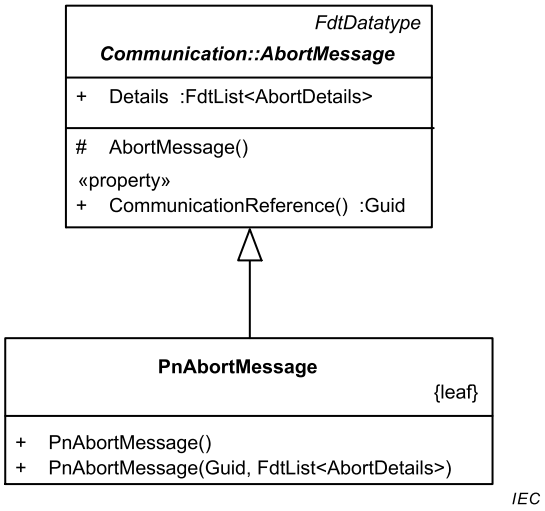


Figure 19 – PnAbortMessage

Table 20 – PnAbortMessage datatype

Property	Usage	Multiplicity	Description
CommunicationReference	M	[1..1]	Mandatory identifier for a communication link to a device. This identifier is allocated by the communication component during the Connect. The address information shall be used for all following communication calls.

10.8 PnResponseError

10.8.1 Communication error

The class PnResponseError describes the IEC 61784 CPF 3/3 specific communication error (see Figure 20 and Table 21). If a transaction fails, the response object shall provide either the response error or error information. If the failure is specific to PROFINET, the response error shall be used. If the failure is related to nested communication, the error information shall be used.

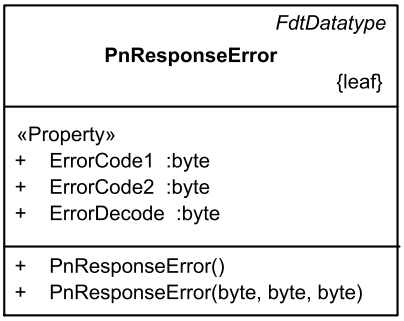


Figure 20 – PnResponseError

Table 21 – PnResponseError datatype

Property	Usage	Multiplicity	Description
ErrorDecode	M	[1..1]	Status information according to the IEC 61784 CPF 3/3 specification
ErrorCode1	M	[1..1]	Status information according to the IEC 61784 CPF 3/3 specification
ErrorCode2	M	[1..1]	Status information according to the IEC 61784 CPF 3/3 specification

10.8.2 Handling of errors during Connect and Disconnect

If an error occurs during of an IEC 61784 CPF 3/3 connect or disconnect request, the communication component shall return an object of type CommunicationError. The error coding shall be done in the field ErrorCode. The ErrorCode shall contain the IEC 61784 CPF 3/3 error information “ErrorDecode”, “ErrorCode1”, “ErrorCode2” exactly in this sequence.

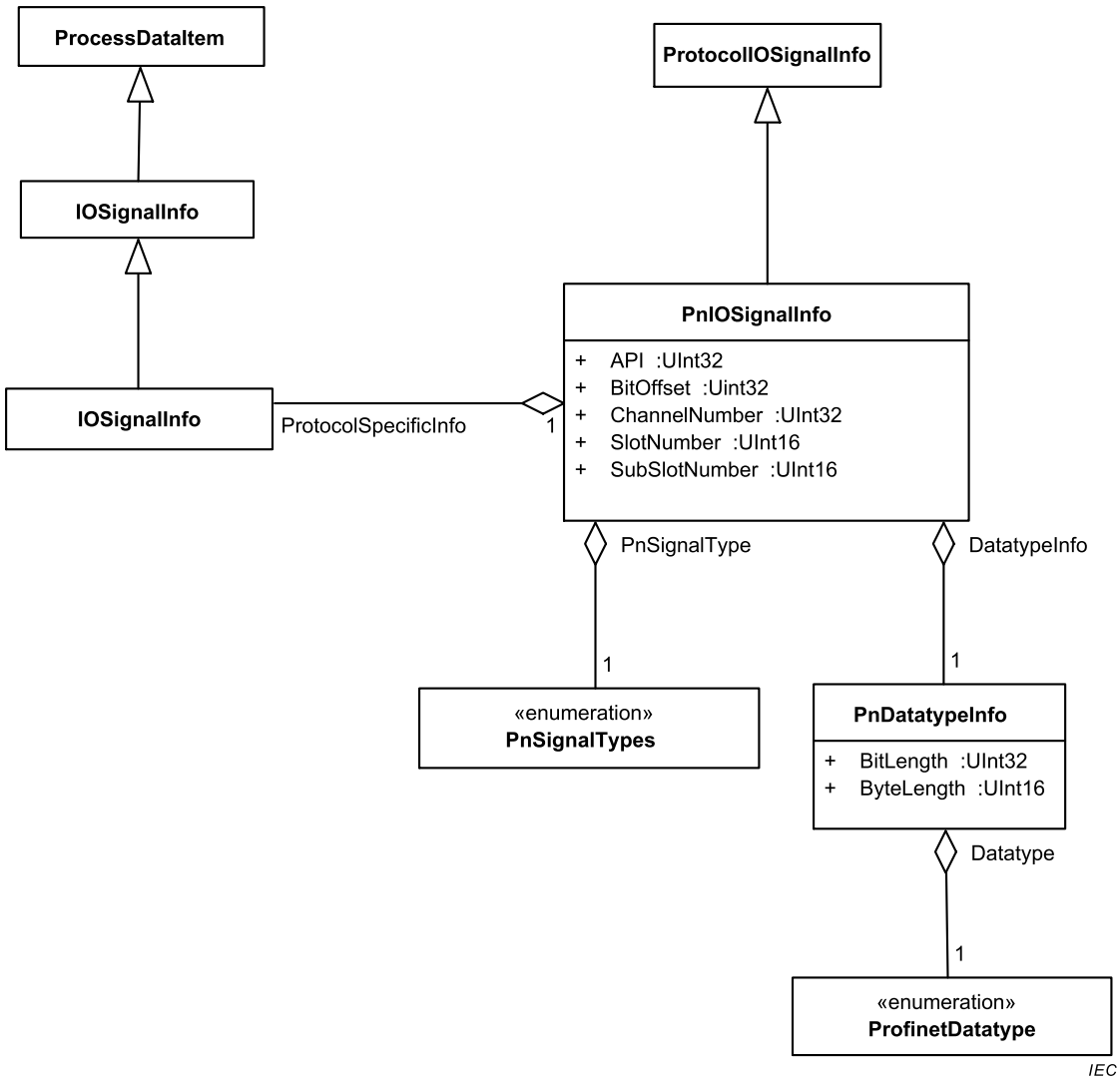
11 Datatypes for process data information

11.1 General

ProcessData in a DTM can be used to represent the “Process values” available on that device. A Process Control System (i.e. some external system which monitors values on a device) can query the DTM’s ProcessData for its properties. The ProcessData describes the process values such that an external system can use the information to access and interpret the values from the device during normal device runtime. The external system might not use FDT to access the values.

11.2 PnIOSignalInfo

This is the PROFINET specific implementation of the abstract class ProtocolIOSignalInfo (see Figure 21).



Used in:

IProcessData::<ProcessData>()

IProcessData::SetIOSignalInfo()

Figure 21 – ProtocolIOSignalInfo

The properties of the datatype are described in Table 22 and Table 23.

Table 22 – PnDatatypeInfo

Property	Usage	Multiplicity	Description
ByteLength	O	[0..1]	Should only be used to describe the ByteLength of the datatypes Visible-String and OctetString.
BitLength	O	[0..1]	Should only be used to describe the BitLength of the datatypes BitArea.
ProfinetDatatype	M	[1..1]	Protocol specific datatype

Table 23 – ProtocolIIOSignalInfo datatypes

Property	Usage	Multiplicity	Description
API	M	[1..1]	API
ChannelNumber	M	[1..1]	Channel number
SlotNumber	M	[1..1]	Slot number
SubSlotNumber	M	[1..1]	SubSlotNumber
BitOffset	M	[1..1]	BitOffset

11.3 Mapping of PROFINET datatypes to FDT datatypes

The datatype mapping shall fulfill two functions:

– The datatype defines the string representation formatting rules for a certain value provided in protocol specific datatypes. The related string formats are defined by W3C standards. The binary layout of datatypes for parameterization purpose is defined by the Microsoft datatypes.

– The datatype describes the binary format of IO signals contained in cyclic communication. The binary layout of all datatypes is defined in the IEC 61158 series.

Therefore the FDT defined datatypes have to be compared to the Microsoft .NET datatypes.

See Table 1 for a mapping of datatypes.

The format of all datatypes is defined in the IEC 61158 series.

12 Device identification

12.1 General

A PROFINET scan may detect different device types: I&M devices or pure DCP devices. Depending on the detected device type, not all properties of PnDeviceScanInfo or PnDeviceIdentInfo are available. The BusProtocol property shall be set either to Profinet_BusProtocol.protocol_DCP or Profinet_BusProtocol.protocol_IM to indicate the identification type for the device.

There is a strong recommendation for the developers of communication DTMs, to support PnDeviceScanInfo in two steps: The first scan should be done via DCP. The second scan should be done via I&M (0 and 1). The scan result is a merged data structure containing both information (DCP and I&M).

12.2 PnDeviceScanInfo datatype

This is the protocol-specific implementation of the DeviceScanInfo (see Figure 22 and Table 25).

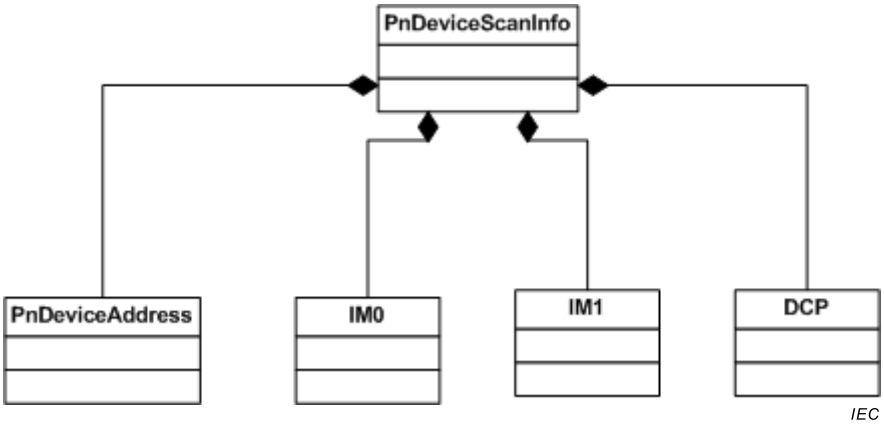


Figure 22 – PnDeviceScanInfo datatype

The properties of the datatypes are described in Table 24.

Table 24 – PnDeviceScanInfo datatype

Property	Description
ConfiguredState	
PnDeviceAddress	Address information of scanned device
BusProtocolId	ProtocolId
BusProtocol	Protocol used for scan (DCP or IM)
ScannedPhysicalLayer	Determines the physical medium for which the scan information is provided
DCP	PROFINET DCP data
IM0	PROFINET IM0 data
IM1	PROFINET IM1 data

Table 25 defines the semantics of PnDeviceScanInfo properties and how this information is mapped to predefined properties of DeviceScanInfo.

The Communication Channel will read these values from the device and write them into the properties of PnDeviceScanInfo.

Table 25 – PnDeviceScanInfo specific mapping

PnDeviceScanInfo property name	Datatype	Mapped to property name in DeviceScanInfo	Data request in Physical device	Protocol specific name	Pnio data format	Specific reference
PnDeviceAddress.IPAdress	System.Net.IPAddress	Address	-	IP-parameter	-	-
PnDeviceAddress.IPDefaultGateway	System.Net.IPAddress	Address	-	Standard Gateway	-	-
PnDeviceAddress.IPSubnetMask	System.Net.IPAddress	Address	-	Subnet Mask	-	-
PnDeviceAddress.MacAddress	byte[6]	Address	-	MAC address	-	-
PnDeviceAddress.NameOfStation	string	Address	-	NameOfStation	-	-
ConfiguredState	int?		-	-	-	-
BusProtocolId	GUID	ProtocolId	-	-	-	-
BusProtocol	Profinet_BusProtocol	-	-	-	-	-
ScannedPhysicalLayer	PhysicalLayer	PhysicalLayer	-	-	-	-
IM0.IM_Vendor_ID	uint	ManufacturerId	I&M 0 Element 1	MANUFACTURER_ID	UNSIGNED16	-
DCP.DeviceVendorValue	uint	ManufacturerId	DCP DeviceVendorValue	MANUFACTURER_ID	UNSIGNED16	-
IM1.DeviceName	string	Tag	I&M 1 Element 1			-
IM0.IM_Order_ID	string	DeviceTypeId	I&M 0 Element 2	OrderID	Visible String[20]	-
DCP.DeviceIdentNumber	uint	DeviceTypeId				
IM0.IM_Serial_Number	string	SerialNumber	I&M 0 Element 3	Unique serial number	Visible String[16]	-
IM0.IM_Hardware_Revision	string	HardwareRevision	I&M 0 Element 4	HARDWARE_REVISION	Unsigned16	-
IM0.IM_Software_Revision	string	SoftwareRevision	I&M 0 Element 5	SOFTWARE_REVISION	4 Octets -1 Char +3 Unsigned8 e.g. V1.3.0	-
IM0.IM_Profile_ID	int?	ProtocolSpecificProperty	I&M 0 Element 7	PROFILE_ID	Unsigned16	-
IM0.IM_Profile_Specific_Type	Int?	ProtocolSpecificProperty	I&M 0 Element 8	PROFILE_SPECIFIC_TYPE	Unsigned16	-
DCP.DeviceRoleDetail	Profinet_DeviceRole	ProtocolSpecificProperty	DCP DeviceRoleDetail	DeviceRoleDetails	Unsigned8	-

PnDeviceScanInfo property name	Datatype	Mapped to property name in DeviceScanInfo	Data request in Physical device	Protocol specific name	Pnio data format	Specific reference
DCP.ManufacturerSpecificString	string	ProtocolSpecificProperty	DCP ManufacturerSpecific String	ManufacturerSpecific String	OctetString[Size according to DCPBlockLength]	-

12.3 PnDeviceIdentInfo datatype

PnDeviceIdentInfo provides PROFINET specific identifications of supported device types returned by GetDeviceInfo() (see Figure 23 and Table 26). For DTM assigned after Fieldbus-scanning, the frame application can check in a protocol independent way, if the identification of a scanned device type (DeviceScanInfo) matches to the supported DeviceInfo.

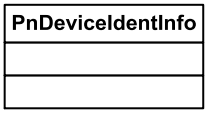


Figure 23 – PnDeviceIdentInfo

Table 26 – PnDeviceIdentInfo datatypes

Property	Description
BusProtocolId	ProtocolId
IdDtmSupportLevel	Enumeration value of the support Level of the DTM: genericSupport, profileSupport, blockspecificSupport, specificSupport
DeviceVendorValue	Manufacturer identification number
DCP_DeviceIdentNumber	Device ident number
DCP_DeviceRoleDetail	Device role detail
DCP_ManufacturerSpecificString	Manufacturer specific string
IM_Order_ID	The complete order number or at least the relevant part that allows unambiguous identification of the device within the manufacturer's website (IM data)
IM_Software_Revision	Revision of the device embedded software (IM data)
IM_Hardware_Revision	Hardware revision of the device (IM data)
IM_Profile_ID	The profile identification for the device (IM data)
IM_Profile_Specific_Type	Additional profile identification information of the device (IM data)

Table 27 defines the semantics of PnDeviceIdentInfo properties and how this information is mapped to predefined properties of DeviceIdentInfo.

Table 27 – PnDeviceIndentInfo specific mapping

PnDeviceIdentInfo property name	Datatype	Mapped to property name in DeviceIdentInfo	Data request in physical device	Protocol specific name	Pnio data format	Specific reference
BusProtocol	GUID	-	-	-	-	-
IdDTMSupportLevel	Profinet_DTMSupportLevel	-	-	-	-	-
DeviceVendorValue	uint	ManufacturerId	I&M 0 Element 1 or DCP DeviceVendorValue	MANUFACTURER_ID	UNSIGNED16	-
DCP_DeviceIdentNumber	uint	DeviceTypeId	DCP DeviceIdentNumber	DeviceIdentNumber	Unsigned16	-
DCP_DeviceRoleDetail	Profinet_DeviceRole	ProtocolSpecificProperty	DCP DeviceRoleDetail	DeviceRoleDetail	Unsigned8	-
DCP_ManufacturerSpecificString	string	ProtocolSpecificProperty	DCP ManufacturerSpecificString	ManufacturerSpecificString	OctetString[Size according to DCPBlockLength]	-
IM_Order_ID	string	ProtocolSpecificProperty	I&M 0 Element 2	OrderID	Visible String[20]	-
IM_Hardware_Revision	string	HardwareRevision	I&M 0 Element 4	HARDWARE_REVISION	Unsigned16	-
IM_Software_Revision	string	SoftwareRevision	I&M 0 Element 5	SOFTWARE_REVISION	4 Octedts -1 Char +3 Unsigned8 e.g. V1.3.0	-
IM_Profile_ID	int?	ProtocolSpecificProperty	I&M 0 Element 7	PROFILE_ID	Unsigned16	-
IM_Profile_Specific_Type	Int?	ProtocolSpecificProperty	I&M 0 Element 8	PROFILE_SPECIFIC_TYPE	Unsigned16	-

The PnDeviceIdentInfo properties may have either a single value which shall exactly match the supported device, or a range of matching values may be defined in regular expressions.

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch