



BSI Standards Publication

Field device tool (FDT) interface specification

Part 52-31: Communication implementation for common
language infrastructure - IEC 61784 CP 3/1 and CP 3/2

National foreword

This Published Document is the UK implementation of CLC IEC/TR 62453-52-31:2019. It is identical to IEC TR 62453-52-31:2017.

The UK participation in its preparation was entrusted to Technical Committee GEL/65/3, Industrial communications: process measurement and control, including fieldbus.

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

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English Version

**Field device tool (FDT) interface specification - Part 52-31:
Communication implementation for common language
infrastructure - IEC 61784 CP 3/1 and CP 3/2
(IEC/TR 62453-52-31:2017)**

Spécification des interfaces des outils des dispositifs de terrain (FDT) - Partie 52-31: Mise en œuvre d'un profil de communication pour l'infrastructure commune de langage - CP 3/1 et CP 3/2 de l'IEC 61784 (IEC/TR 62453-52-31:2017)

Field Device Tool (FDT)-Schnittstellenspezifikation - Teil 52-31: Kommunikationsimplementierung mit der allgemeinen Sprachinfrastruktur - Kommunikationsprofilfamilie (CPF) 3/1 und 3/2 nach IEC 61784 (IEC/TR 62453-52-31:2017)

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European foreword

This document (CLC IEC/TR 62453-52-31:2019) consists of the text of IEC/TR 62453-52-31:2017 prepared by SC 65E "Devices and integration in enterprise systems" of IEC/TC 65 "Industrial-process measurement, control and automation".

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Endorsement notice

The text of the International Standard IEC/TR 62453-52-31:2017 was approved by CENELEC as a European Standard without any modification.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where 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.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61131-3	2003	Programmable controllers -- Part 3: Programming languages	-	-
IEC 61158	series	Industrial communication networks - Fieldbus specifications - Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	EN 61158	series
IEC 61158-6-3	2014	Industrial communication networks - Fieldbus specifications - Part 6-3: Application layer protocol specification - Type 3 elements	EN 61158-6-3	2014
IEC 61784-1	2014	Industrial communication networks - Profiles - Part 1: Fieldbus profiles	EN 61784-1	2014
IEC 62453-1	2016	Field device tool (FDT) interface specification - Part 1: Overview and guidance	EN 62453-1	2017
IEC 62453-2	2016	Field device tool (FDT) interface specification - Part 2: Concepts and detailed description	EN 62453-2	2017
IEC TR 62453-42	2016	Field device tool (FDT) interface - specification - Part 42: Object model integration profile - Common language infrastructure	-	-
IEC 62453-303-1	2009	Field device tool (FDT) interface specification - Part 303-1: Communication profile integration - IEC 61784 CP 3/1 and CP 3/2	EN 62453-303-1	2009

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

**Part 52-31: Communication implementation
for common language infrastructure –
IEC 61784 CP 3/1 and CP 3/2**

FOREWORD

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IEC TR 62453-52-31, 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. The corresponding part for this document is IEC 62453-303-1.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 fieldbuses 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.

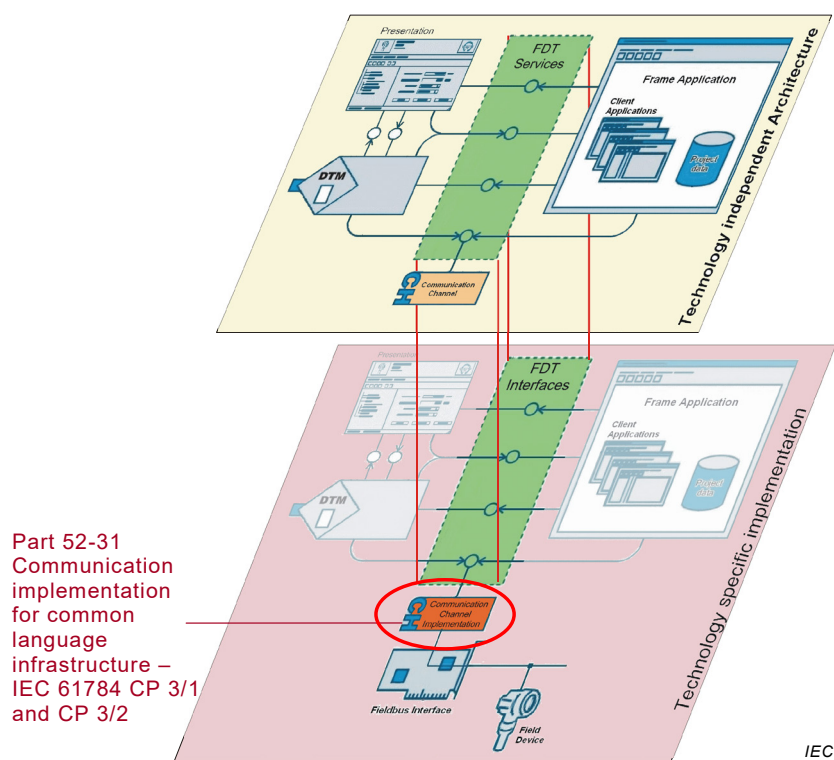


Figure 1 – Part 52-31 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 52-31: Communication implementation for common language infrastructure – IEC 61784 CP 3/1 and CP 3/2

1 Scope

This part of the IEC 62453-52-xy series, which is a Technical Report, provides information for integrating the PROFIBUS¹ 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 62453-303-1.

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 61131-3:2003, *Programmable controllers – Part 3: Programming languages*

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

IEC 61158-6-3:2014, *Industrial communication networks – Fieldbus specifications – Part 6-3: Application layer protocol specification – Type 3 elements*

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 62453-303-1:2009, *Field device tool (FDT) interface specification – Part 303-1: Communication profile integration – IEC 61784 CP 3/1 and CP 3/2*
IEC 62453-303-1:2009/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 62453-303-1 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 Symbols and abbreviated terms

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

3.3 Conventions

3.3.1 Datatype names and references to datatypes

The conventions for naming and referencing of datatypes are explained in IEC TR 62453-2:2016, Clause A.1.

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 “conditional”	Function or behaviour shall be provided, depending on defined conditions.
Usage of “can” or “optional”	Function or behaviour may be provided, depending on defined conditions.

3.3.3 Use of UML

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

4 Bus category

IEC 61784 CP 3/1 and IEC 61784 CP 3/2 protocols are identified in the attribute ProtocolId of the BusCategory element by the identifiers, as specified in IEC 62453-303-1.

The supported PhysicalLayer are identified by the Identifier values as specified in IEC 62453-303-1.

The supported DataLinkLayer are identified by the Identifier values as specified in IEC 62453-303-1.

5 Access to instance and device data

5.1 General

The minimum set of data provided by a Device DTM shall be:

- All device parameters of the Physical Block and Out value of the Function Blocks shall be exposed via the data interfaces (PROFIBUS PA devices).
- All process values available for the device shall be modelled as ProcessData including the ranges and scaling, if applicable.
- All network configuration related parameters shall be exposed in NetworkData (see Clause 8).

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 10.

5.3 Data interfaces

5.3.1 General

Via the interfaces IDeviceData and IInstanceData all device specific parameters shall be exposed.

5.3.2 Mapping of PROFIBUS datatypes to FDT datatypes

PROFIBUS 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 defined in IEC 61131-3. Hence a mapping between these three type systems is defined in Table 1.

Table 1 – Mapping of datatypes

PROFIBUS datatype	FDT datatype	IEC 61131 datatype
Bit information		
Boolean	BooleanValue	BOOL
Unsigned8	BinaryBitArrayValue[8]	BYTE
Unsigned16	BinaryBitArrayValue[16]	WORD
Unsigned32	BinaryBitArrayValue[32]	DWORD
Numeric information with and without sign		
Integer8	SignedByteValue	SINT
Integer16	IntValue	INT
Integer32	LongValue	DINT
Unsigned8	ByteValue	USINT
Unsigned16	UIntValue	UINT
Unsigned32	ULongValue	UDINT
Float32	FloatValue	REAL
Float64	DoubleValue	LREAL
Printable characters (e.g. text)		
Visible String	StringValue	STRING
Unicode String	StringValue	WSTRING

PROFIBUS datatype	FDT datatype	IEC 61131 datatype
Time information		
TimeDifference without Date Indication	TimeSpanValue	TIME
Date	DateValue	DATE
Time Of Day without date indication	TimeValue	TIME_OF_DAY
Time of Day with date indication	DateTimeValue	DATE_AND_TIME
Combinations of basic datatypes		
Octet String	BinaryByteArrayValue	ARRAY
ARRAY	StructDataGroup	ARRAY
STRUCT OF	StructDataGroup	STRUCT

The FDT datatypes are used by the <Read> and <Write> methods in the interfaces IInstanceData and IDeviceData.

5.3.3 SemanticInfo

The identifier in SemanticId shall be unique and always reference the same element. This means the semantic information shall be the same whenever the same data is referenced. By using this attribute e.g. a Frame Application is able to get the information regarding the meaning and usage of a single data structure.

Table 2 – Usage of general datatypes

Attribute	Description for use
SemanticInfo.ReadParameterAddress SemanticInfo.WriteParameterAddress	<p>For PROFIBUS, ReadParameterAddress and WriteParameterAddress are always identical. The address string shall be constructed according to the rules of the FDT SemanticId.</p> <p>PROFIBUS Parameter Address:</p> <p>The property 'Address' follows the different device models that are defined for PROFIBUS devices. FDT currently supports the following models:</p> <ul style="list-style-type: none"> – PROFIBUS DP / DP-V1, – PROFIBUS PA, – PROFIdrive (greater or equal profile version 3) <p>PROFIBUS DP / DP-V1</p> <p>The device model is based on devices that are composed of slots, whereas slots do not have to represent physical objects. The data that is contained in the slots are addressable via Indexes. This data may be variables or composed blocks of data.</p> <p>The Address property is APIxxSLOTyyINDEXzz</p> <p>xx – API yy – Slot zz – Index</p> <p>xx, yy, zz are based on decimal format without leading '0'</p>

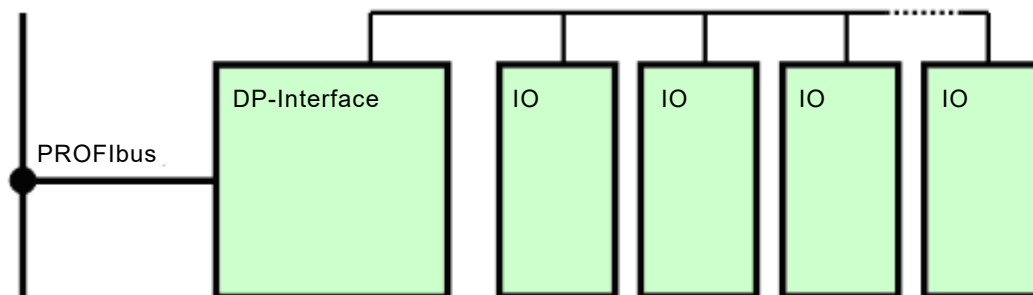
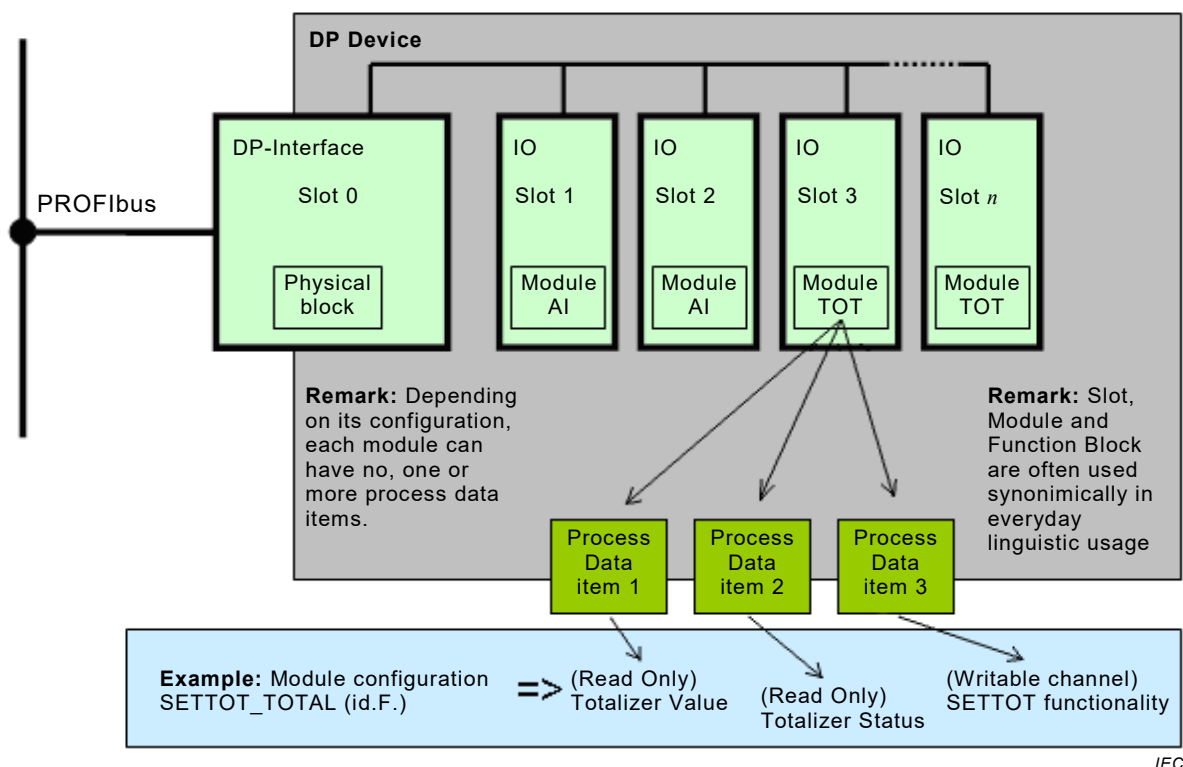
Attribute	Description for use
	<p>PROFIBUS PA</p> <p>The device is represented by a device management structure and a number of blocks that provide different functionality (physical block, function block, transducer block). The blocks are mapped to slot addresses, but this mapping may vary depending on the device type.</p> <p>The Address property is APIxxSLOTyyINDEXzz</p> <p>xx – API yy – Slot zz – Index</p> <p>xx, yy, zz are based on decimal format without leading '0'</p> <p>PROFIdrive</p> <p>According to the PROFIdrive profile [5], a device (drive unit) may be composed by a number (1..many) of drive objects (DOs). The DOs may have different type. Each DO is uniquely identifiable and manages its own parameters. Each parameter can be uniquely identified by its number (PNU). Each DO has its own number space.</p> <p>A parameter may contain simple data or composed data (e.g. arrays).</p> <p>The data of the device are accessible via a parameter channel (normally slot 0 index 47).</p> <p>The Address property is APIxxSLOTyyINDEXzz.DOdo-id.pnu</p> <p>xx – API yy – Slot zz – Index do-id – Drive Object ID pnu – ParameterNumber</p> <p>xx, yy, zz, do-id, pnu are based on decimal format without leading '0'</p>
SemanticInfo.ApplicationDomain/ SemanticInfo.SemanticId	<p>The SemanticIDs for PROFIBUS follow the different device models that are defined for PROFIBUS devices. FDT currently supports the following models:</p> <ul style="list-style-type: none"> – PROFIBUS DP, – PROFIBUS PA, – PROFIdrive. <p>PROFIBUS DP / DP-V1</p> <p>The ApplicationDomain is: FDT_PROFIBUS_DPV1</p> <p>The device model is based on devices that are composed of slots, whereas slots do not have to represent physical objects. The data that is contained in the slots are addressable via Indexes. This data may be variables or composed blocks of data.</p> <p>The SemanticId for devices not based on a profile is directly based on the PROFIBUS address information:</p> <p>The SemanticId is: APIxx.SLOTyy.INDEXzz</p> <p>xx – AP yy – Slot zz – Index</p> <p>xx, yy, zz are based on decimal format without leading '0'</p>

Attribute	Description for use
	<p>PROFIBUS PA</p> <p>The ApplicationDomain is: FDT_PROFIBUS_PA</p> <p>The device is represented by a device management structure and a number of blocks that provide different functionality (physical block, function block, transducer block). The blocks are mapped to slot addresses, but this mapping may vary depending on the device type. Since the device model is based on blocks, the SemanticIds also are based on the block model. Within each block, the data is identifiable by names of parameters.</p> <p>The SemanticId for PROFIBUS profile related parameter follows the following rules:</p> <ul style="list-style-type: none"> – the SemanticId shall be built based on the names defined in the profiles; – structured parameters shall be combined with a '.'; – spaces within the profile definition shall be exchanged with an underscore; – blocks shall be counted according to the Object Dictionary; – the block number shall be part of the SemanticId. <p>The SemanticId is</p> <p style="text-align: center;">BlockType.BlockIndex.NameOfParameter.AttributeOfParameter</p> <p>EXAMPLE</p> <p style="text-align: center;">AnalogInputFB.3.OUT.Unit</p>
(cont. SemanticInfo.ApplicationDomain/ SemanticInfo.SemanticId)	<p>PROFIdrive</p> <p>The ApplicationDomain is: FDT_PROFIBUS_PROFIDRIVE</p> <p>According to the PROFIdrive profile, a device (drive unit) may be composed by a number (1..many) of drive objects (DOs). The DOs may have different types. Each DO is uniquely identifiable and manages its own parameters. Each parameter can be uniquely identified by its number (PNU). Each DO has its own number space.</p> <p>A parameter may contain simple data or composed data (e.g. arrays).</p> <p>The data of the device are accessible via a parameter channel (slot 0, index 47).</p> <p>The SemanticId is: DOdo-id.PNUpnu</p> <p style="text-align: center;">do-id – Drive Object ID pnu – ParameterNumber</p> <p>do-id, pnu are based on decimal format without leading '0'</p> <p>EXAMPLE</p> <p style="text-align: center;">DO3.PNU64</p>

6 Protocol specific behaviour

6.1 PROFIBUS device model

The definition of Process Data Items for the description of I/O values shall be structured according to the PROFIBUS device model (see Figure 2).

Classical View of PROFIBUS device**PROFIBUS notations from a device DTMs point of view****Figure 2 – FDT PROFIBUS Device Model**

DTMs for PROFIBUS devices shall provide information about their I/O data to provide engineering systems knowledge to access such data without the use of the DTMs.

6.2 Configuration and parameterization of PROFIBUS devices**6.2.1 General**

In a GSD-based configuration tool, the user defines the configuration and sets the appropriate parameters for the modules. The configuration tool creates the configuration string and the parameter string that are used to set up the slave properly.

With FDT the configuration and parameterization of the devices is no longer executed only by a central piece of software; it moved partly into the DTMs. A Device DTM is responsible for providing configuration and parameterization information for a PROFIBUS master that puts the PROFIBUS slaves in operation.

A Device DTM is used to adjust a field device to its specific application. Within PROFIBUS, there are three different aspects of adjustment:

- Communication parameterization: User Prm Data (used in the PROFIBUS service Set_Prm for setting up the cyclic communication and the specific behaviour of the device);
- Configuration data: Cfg Data (used in the PROFIBUS service Chk_Cfg for definition of the format and length of the input/output data that are transmitted within cyclic communication);
- Application parameterization: application specific parameters (transmitted via acyclic read/write PROFIBUS services).

The application parameterization transmitted via acyclic communication is not in the scope of this document. The parameter data transmitted for this purpose is device specific. Only the communication services that can be used by Device DTMs for performing such device specific parameterization are defined. Within this document the term parameterization represents communication parameterization (Set_Prm).

6.2.2 Monolithic DTM for a modular PROFIBUS device

A monolithic DTM is one single DTM that represents the complete device with its Bus Interface Module (BIM) and its I/O modules. In general, such a DTM offers a configuration user interface (presentation object) that allows definition of the used BIM and module types.

Not all PROFIBUS devices require a configuration user interface. That is why not all DTMs provide the configuration function (ApplicationID: Configuration). This is valid only for non-modular PROFIBUS devices if the User Prm Data cannot be changed.

The configuration dialog shall allow changing the data only in offline mode if the data set can be locked.

6.2.3 Composite DTM for a modular PROFIBUS device

Separate DTMs represent the BIM (Composite Device DTM) and the particular I/O modules (Module DTMs). The effort developing such a modular DTM is normally higher than in the case of a monolithic DTM, because:

- a private protocol shall be implemented between BIM and I/O modules to ensure that only a Module DTM can be added to the BIM DTM. This requires an own FDT protocol ID and the adaptation/creation of FDT communication datatypes.

Implementing a Modular DTM results in the following advantages:

- the project topology represents the device structure,
- the user is able to access module-related information directly as a function of the Module DTM,
- IEC 62453 defines a mechanism to identify DTMs. With these mechanisms it is possible to provide support for scanning the modules below the BIM and generate the topology automatically,
- supporting a new type of BIM or I/O module requires an additional DTM “only” and does not affect existing components. This may result in reduced test effort that can also simplify the certification process.

The configuration data to set up the PROFIBUS configuration of a modular PROFIBUS device shall be provided by the Device DTM representing the BIM. This configuration data may be generated from information of the instantiated Module DTMs and by using a configuration dialog.

Modular DTMs can be provided for modular devices (e.g. a plant operator may add/remove modules). Monolithic DTMs can be used to represent devices that show no modularity (e.g. PA devices).