PD IEC TS 62453-53-31:2025

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Field Device Tool (FDT) Interface Specification

Part 53-31: Communication implementation for CLI and HTML — IEC 61784 CP 3/1 and CP 3/2

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Full document details: PD IEC TS 62453-53-31:2025

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The UK participation in its preparation was entrusted to Technical Committee GEL/65/5, Devices and integration in enterprise systems.

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

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ISBN 978 0 539 21172 6

ICS 25.040.40; 35.100.05; 35.110

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 March 2025.

Amendments/corrigenda issued since publication

Date	Text affected

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Full document details: PD IEC TS 62453-53-31:2025

IEC TS 62453-53-31

Edition 1.0 2025-03

TECHNICAL SPECIFICATION

Field Device Tool (FDT) Interface Specification – Part 53-31: Communication implementation for CLI and HTML – IEC 61784 CP 3/1 and CP 3/2

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40; 35.100.05; 35.110

ISBN 978-2-8327-0283-3

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FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 53-31: Communication implementation for CLI and HTML – IEC 61784 CP 3/1 and CP 3/2

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The text of this Technical Specification is based on the following documents:

Draft	Report on voting
65E/1110/DTS	65E/1161/RVDTS

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

The language used for the development of this Technical Specification is English.

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This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62453 series, published 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- revised.

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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 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 62453-53-xy series is aligned in the structure of the IEC 62453 series.

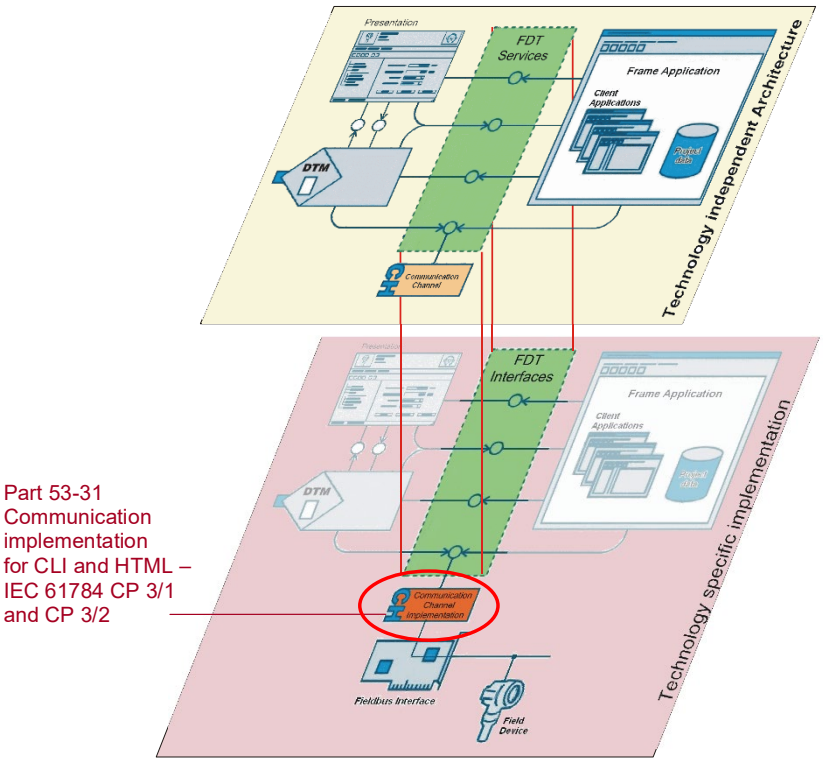

Figure 1 – Relation of IEC TS 62453-53-31 to the IEC 62453 series

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FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 53-31: Communication implementation for CLI and HTML – IEC 61784 CP 3/1 and CP 3/2

1 Scope

This part of the IEC 62453-53-xy series, which is a Technical Specification, provides information for integrating the PROFIBUS[1] technology into the CLI-based implementation of FDT interface specification (IEC TS 62453-43).

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

IEC 61784 (all parts), *Industrial communication networks – Profiles*

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

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

IEC TS 62453-43, *Field device tool (FDT) interface specification – Part 43: Object model integration profile – CLI and HTML*

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

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3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62453-1, IEC 62453-2, IEC TS 62453-43, and the following 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

3.1.1
bus interface module
module of a field device that provides the connection to the fieldbus

3.1.2
CP 3/1
Communication profile of PROFIBUS DP, featuring asynchronous transmission, RS-485 (ANSI TIA/EIA RS-485-A), optional RS-485-IS, plastic fiber, glass multi mode fiber or glass single mode fiber and PCF fiber

3.1.3
CP 3/2
Communication profile of PROFIBUS PA, featuring synchronous transmission, Manchester coded, Bus Powered (MBP), optional intrinsically safe (MBP-IS) and lower power (MBP-LP)

3.1.4
Master Class 1
master with control capability

Note 1 to entry: In a DP-V0 environment, depending on the situation, the underlying master device may have either Master Class 1 (DPM1) functionality or Master Class 2 (DPM2) functionality. A Class 1 master can write output data to a device and control data exchange.

3.1.5
Master Class 2
master without control capability

Note 1 to entry: In a DP-V0 environment, depending on the situation, the underlying master device may have either Master Class 1 (DPM1) functionality or Master Class 2 (DPM2) functionality. A Class 2 master can only read the output data.

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3.2 Abbreviated terms

ANSI	American National Standards Institute (http://www.ansi.org)
BIM	Bus Interface Module
CFG	Configuration data used during initialization of PROFIBUS slave device
DCS	Distributed Control System
DP	Decentralized Peripherals
EIA	Electronic Industries Alliance
FDL	Fieldbus Data Link layer
FMA	Fieldbus Management layer
FMS	Fieldbus Message Specification
GSD	General Station Description
MBP	Manchester coded Bus Powered
PND	PROFIBUS Network Data
I&M	Identification and maintenance functions
PA	Process Automation
PCF	Polymer Clad Fibre
PROFIBUS	Process FieldBus
RS	Radio Sector / Recommended Standard
TIA	Telecommunications Industry Association
UML	Unified Modeling Language

3.3 Conventions

3.3.1 Data names and references to datatypes

The conventions for naming and referencing of datatypes are explained in IEC TS 62453-43.

3.3.2 Further conventions

Further conventions are:

Convention	Indicates
<MethodName>	Angle brackets are used to indicate a reference to an asynchronous method.

3.3.3 Use of UML

Figures in this document are using UML notation as defined in IEC 62453-1.

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.

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5 Access to instance, device and process data

5.1 General

The minimum set of data provided by a 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 the IEC 61158 series 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

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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 (see Table 2). This means the semantic information shall be the same whenever the same data is referenced. By using this attribute, for example a Frame Application is able to get the information regarding the meaning and usage of a single data structure.

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Table 2 – Usage of SemanticInfo

Attribute	Description for use in PROFIBUS
SemanticInfo.ReadParameterAddress SemanticInfo.WriteParameterAddress	For PROFIBUS, ReadParameterAddress and WriteParameterAddress are always identical. The address string shall be constructed according to the rules of the FDT SemanticId. PROFIBUS Parameter Address: The property 'Address' follows the different device models that are defined for PROFIBUS devices. FDT currently supports the following models: – PROFIBUS DP / DP-V1, – PROFIBUS PA, – PROFIdrive (greater or equal profile version 3) **PROFIBUS DP / DP-V1** The device model is based on devices that are composed of slots, whereas slots do not necessarily 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. The Address property is API*xx*SLOT*yy*INDEX*zz* *xx* – API *yy* – Slot *zz* – Index *xx*, *yy*, *zz* are based on decimal format without leading '0'. **PROFIBUS PA** 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. The Address property is API*xx*SLOT*yy*INDEX*zz* *xx* – API *yy* – Slot *zz* – Index *xx*, *yy*, *zz* are based on decimal format without leading '0' **PROFIdrive** According to the PROFIdrive profile [6], 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. A parameter may contain simple data or composed data (e.g. arrays). The data of the device are accessible via a parameter channel (normally slot 0 index 47). The Address property is API*xx*SLOT*yy*INDEX*zz*.DO*do-id*.*pnu* *xx* – API *yy* – Slot *zz* – Index *do-id* – Drive Object ID *pnu* – ParameterNumber *xx*, *yy*, *zz*, *do-id*, *pnu* are based on decimal format without leading '0'.

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Attribute	Description for use in PROFIBUS
SemanticInfo.ApplicationDomain/ SemanticInfo.SemanticId	The SemanticIDs for PROFIBUS follow the different device models that are defined for PROFIBUS devices. FDT currently supports the following models: – PROFIBUS DP, – PROFIBUS PA, – PROFIdrive. **PROFIBUS DP / DP-V1** The ApplicationDomain is: FDT_PROFIBUS_DPV1 The device model is based on devices that are composed of slots, whereas slots do not necessarily 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. The SemanticId for devices not based on a profile is directly based on the PROFIBUS address information: The SemanticId is: API*xx*.SLOT*yy*.INDEX*zz* *xx – AP* *yy – Slot* *zz – Index* *xx*, *yy*, *zz* are based on decimal format without leading '0' **PROFIBUS PA** The ApplicationDomain is: FDT_PROFIBUS_PA 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. The SemanticId for PROFIBUS profile related parameter follows the following rules: – 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. The SemanticId is *BlockType.BlockIndex.NameOfParameter.AttributeOfParameter* Example AnalogInputFB.3.OUT.Unit **PROFIdrive** The ApplicationDomain is: FDT_PROFIBUS_PROFIDRIVE 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. A parameter may contain simple data or composed data (e.g. arrays). The data of the device are accessible via a parameter channel (slot 0, index 47). The SemanticId is: DO*do-id*.PNU*pnu* *do-id* – Drive Object ID *pnu* – ParameterNumber *do-id*, *pnu* are based on decimal format without leading '0' Example DO3.PNU64

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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).

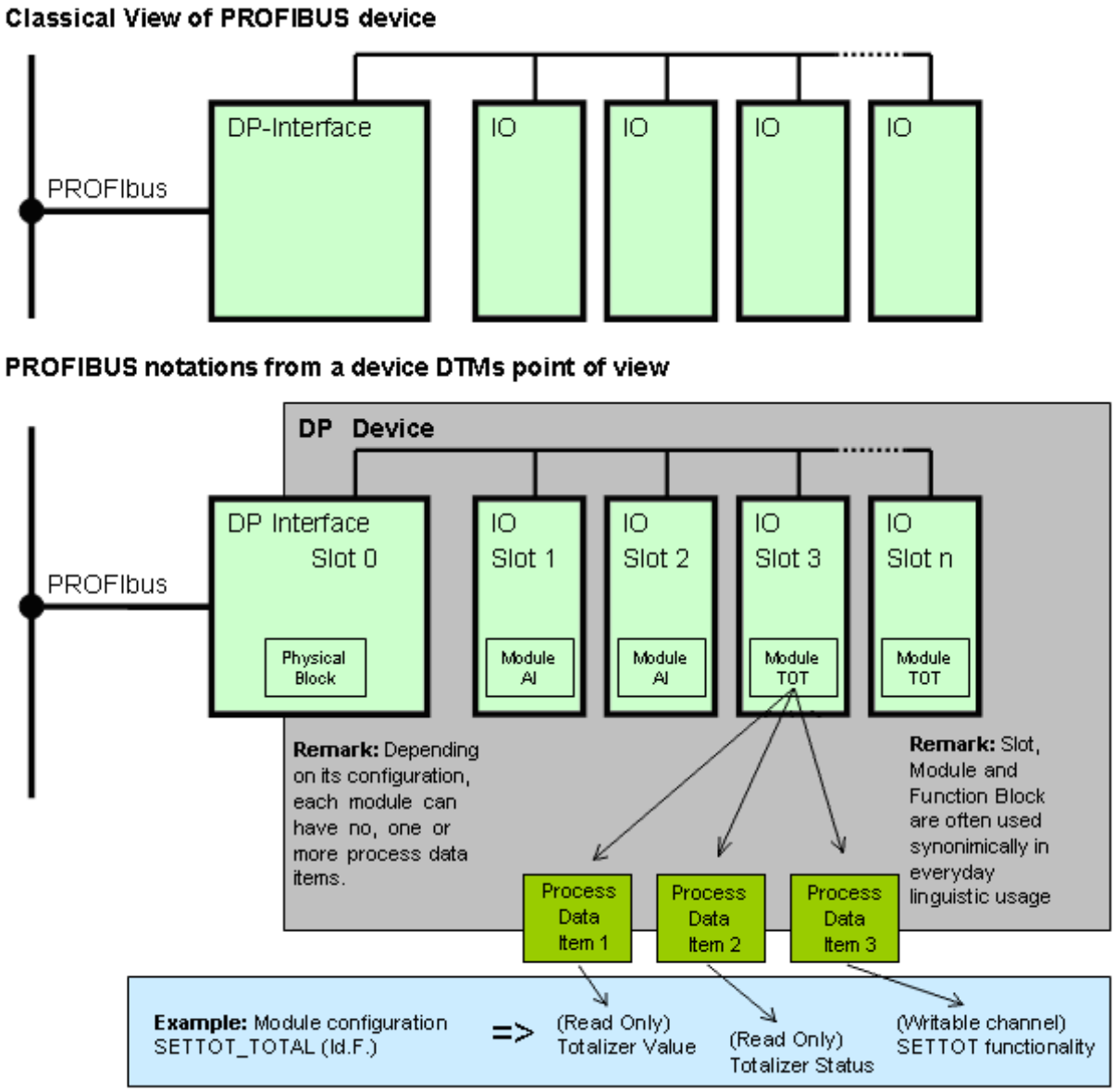

Figure 2 – FDT PROFIBUS Device Model

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.

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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 moves 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.

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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).

6.3 Support for DP-V0 configuration

A PROFIBUS slave usually communicates cyclically via PROFIBUS DP-V0 with a class 1 master (DPM1). In addition to this the slave may support DP-V1 communication. This should be indicated by setting the SlaveFlagDpv1Slave property (see 6.5.2.2.2) to true.

A Gateway DTM for a PROFIBUS slave does not need to provide DP-V0 communication. An example is a remote I/O system with HART[2] modules. It may have a Gateway DTM that requires the DP-V1 protocol and provides the HART protocol. This enables HART Device DTMs to communicate with their devices via the Gateway DTM and via a Communication DTM for DP-V1. Following the specification the Gateway DTM delivers process data items for both protocols DP-V1 and HART. The ProtocolId is a member of NetworkDataInfo datatype.

The Process Data Info of a Device DTM shall contain data items for DP-V0 including all information to allow integration into the control system (e.g. Dpv0IOSignalInfo of the I/O value if available).

6.4 PROFIBUS slaves operating without a class 1 PROFIBUS master

In most cases, a PROFIBUS slave is configured and parameterized by a PROFIBUS class 1 master device. So a running master device in the network is required.

Some slaves (marked via SlaveFlagDpv1Slave) are able to allow acyclic communication without cyclic master to slave communication. Especially in the case of gateway functionality this allows the parameterization of field devices connected to them by using a class 2 master. So instrument specialists are able to work with field devices also in case the controller is not yet working.

If a master starts communication, these devices start to detect bus speed to react properly. This may take some time. A Communication DTM or Gateway DTM shall take this into account and adjust internal timeouts accordingly.

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2 HART ® is the trade name of a product supplied by HART Communication Foundation. This information is given for convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

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In the following, two examples for problems related to detecting devices are described that a user may keep in mind when working with such devices.

EXAMPLE 1
The user performs a network scan. The Communication DTM tries to read diagnostic data via a Dpv0ReadDiagnosis Request but does not receive a response. The device is not detected by the Communication DTM. This occurs mostly when the device has a low PROFIBUS address. The reason is that the device has not completed bus speed detection when it was asked for its diagnostic data. The workaround is to assign these devices a higher PROFIBUS address.

EXAMPLE 2
The user tries to connect a field device linked to a gateway that supports DP-V1 without a running cyclic master. This can lead to an error message because the gateway device has not completed bus speed detection when it is asked for a connection. Consequently the user needs to try to connect again. This happens only in very rare situations.

6.5 PROFIBUS-related information of a slave DTM

6.5.1 General

The information used by a cyclic master device to set up the PROFIBUS network properly and allow cyclic communication between control system and slave devices shall be provided by a DTM in

- PROFIBUS Network Data,
- GSD information,
- Process data items.

A DTM of a PROFIBUS slave shall deliver these parts of PROFIBUS-related information to get integrated into a Frame Application. In 6.5, a more detailed description is given on how to generate and how to provide this information. The actual information depends on the kind of DTM (see 6.2).

6.5.2 PROFIBUS Network Data (PND)

6.5.2.1 PND introduction

The PND of a single DTM instance describes the actual parameter and configuration data of the corresponding PROFIBUS slave. Each DTM representing a PROFIBUS slave device shall provide PROFIBUS Network Data. The PND is the PROFIBUS specific NetworkDataInfo datatype. This information is obtained by calling the service GetNetworkDataInfo.

The PND includes information about the configuration and the parameters for initialization of the slave. The PND is provided by the DTM and is required in order to generate the bus master configuration.

The PND contains data which might be changed during master configuration. That means that the PND may be transferred back to the slave DTM by calling SetNetworkData. A Slave DTM shall accept the new information and recompute the configuration/internal parameters to match the new PND.

The Slave DTM shall check whether the new values are according to the capabilities of the device. The call to SetNetworkData shall be refused (by throwing an exception of type Fdt.FdtInvalidValueException) if the device cannot handle the new values.

6.5.2.2 Creating the PND

6.5.2.2.1 General

The PND may be generated from the GSD information of a PROFIBUS device. Subclause 6.5.2.2 explains the meaning of the individual elements of the PND in detail. The explanations reference the PROFIBUS specification and use the GSD keywords.

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6.5.2.2.2 Slave bus parameter set

All values are provided by the Slave DTM. It is the responsibility of the Slave DTM to be compatible with the Slave GSD. The Master DTM can overwrite some of these initial values sent by the Slave DTM if they depend on the capabilities of the master.

EXAMPLE
Within the GSD file, it is stated that a device supports the Freeze Mode by the keyword “Freeze_Mode_supp”. The master sets the value “PrmDataFreezeMode” within the Slave Bus Parameter Set because only the master knows whether it supports this mode.

Table 3 explains which component is the source of the parameter values (“Information source ”). Some of the values can be changed by the system or by user interaction. If possible, the default values for the parameters are defined (“Default Value”).

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