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2006-05

Field Device Tool (FDT) interface specification –

**Part 5:
FOUNDATION FIELDBUS communication**



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Field Device Tool (FDT) interface specification –

Part 5: FOUNDATION FIELBUS communication

FOREWORD

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IEC-PAS 62453-5 has been processed by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
65C/398A/NP	65C/411/RVN

Following publication of this PAS, which is a pre-standard, the technical committee or subcommittee concerned will transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of three years starting from 2006-05. The validity may be extended for a single three-year period, following which it shall be revised to become another type of normative document or shall be withdrawn.

IEC 62453 consists of the following parts under the general title *Field Device Tool (FDT) interface specification*:

Part 1: Concepts and detailed description

Part 2: INTERBUS communication

Part 3: PROFIBUS communication

Part 4: HART communication

Part 5: FOUNDATION FIELDBUS communication

INTRODUCTION

This PAS is an interface specification for developers of 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 shall inter-operate seamlessly.

With the integration of fieldbusses into control systems, there are a few other tasks which must be performed. This applies to fieldbusses in general. Although there are fieldbus- and device-specific tools, there is no unified way to integrate those 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 DTM (Device Type Manager), 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.

Field Device Tool (FDT) interface specification –

Part 5: FOUNDATION FIELDBUS communication

1 Scope

This part of IEC 62435 provides information for integrating the FOUNDATION FIELDBUS (FF) protocol into the FDT interface specification (IEC 62453-1).

This PAS describes communication schemas, protocol-specific extensions and the means for block (e.g. transducer, resource or function blocks) representation.

The new protocol-specific XML schemas are based on FF specifications for H1 and HSE protocols. Furthermore, the schemas contain information about the device that is needed by systems to configure FF Devices.

The focus of this part is Foundation Fieldbus device configuration.

2 Normative references

The following referenced documents are indispensable for the application 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 62453-1: *Field Device Tool (FDT) interface specification – Part 1: Concepts and detailed description*

IEC 61158 (all parts), *Digital data communications for measurement and control – Fieldbus for use in industrial control systems*

3 Solution concept

3.1 Overview

For the solution, this part provides communication schemas, protocol-specific extensions and means for block (e.g. resource, transducer or function blocks) configuration.

The communication schemas are created to support System Management (SM), Network Management (NM) and Fieldbus Message Specification (FMS).

Separate schemas are designed to support the different management structures for H1 and HSE devices.

Protocol-specific schemas, as required by the FDT Specification, can be used to identify Foundation Fieldbus devices and their internal structure.

A Foundation Fieldbus device is represented by a Device Type Manager (DTM) together with a group of Block Type Manager (BTM). The BTMs represent the function block functionality in an FF device.

The internal device structure is represented by the following topology, see Figure 1.

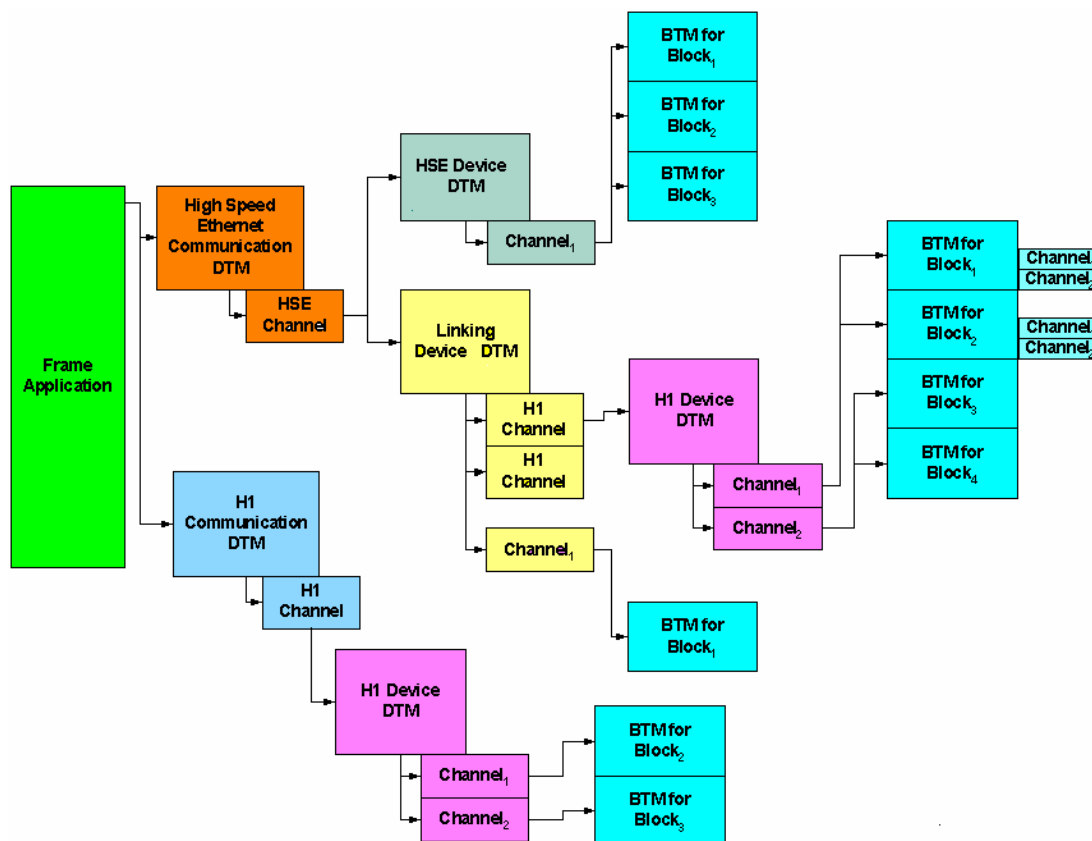


Figure 1 – Example of System Architecture and Components

The following Figure 2 shows all possible object relations for an H1 DeviceDTM.

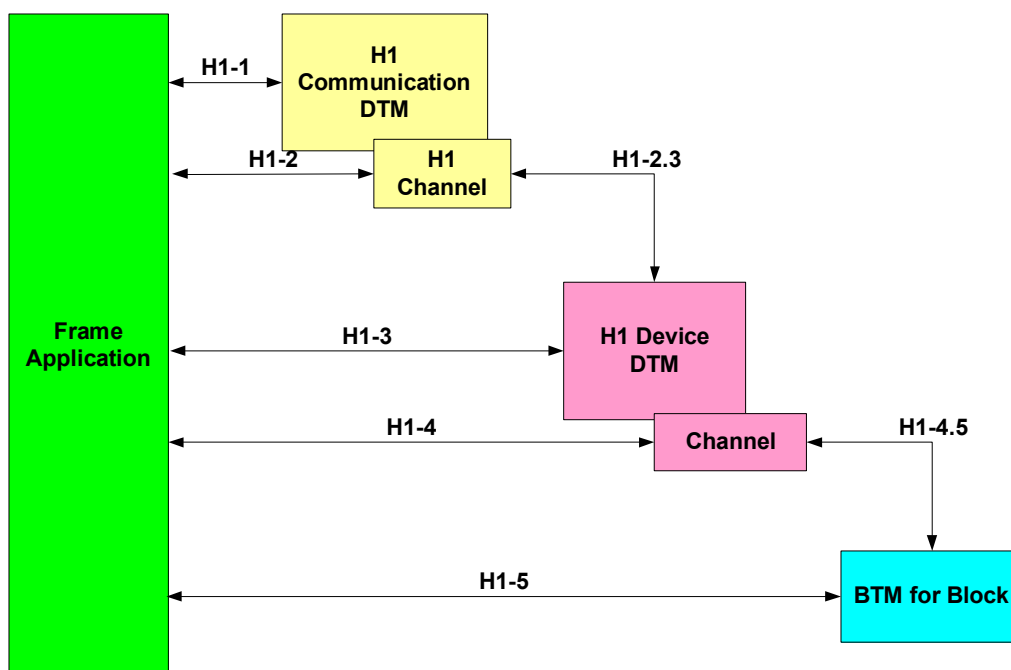


Figure 2 – Object relations for H1 DeviceDTM

For an explanation of the figure components see the following Table 1.

Table 1 – Explanation of object relations for H1 DeviceDTM

Relation	Type of information	Used schemas	Example
H1-1	Management Parameter Access	FdtFFH1ManagementSchema FdtFFDataTypesSchema	FDTFoundationFieldbusH1ManagementSchema
H1-2	Network Topology	DtmFFSchema FdtFFDataTypesSchema FdtFFHseCommunicationSchema	DTMFoundationFieldbusDeviceSchema
	Channel Parameter Access	FDTBasicChannelParameterSchema	FDTFoundationFieldbusChannelParameterSchema
H1-3	Management Parameter Access	FdtFFH1ManagementSchema FdtFFDataTypesSchema	FDTFoundationFieldbusH1ManagementSchema
H1-4	List of instantiated blocks	DtmFFSchema BtmDataTypesSchema FdtFFBlockSchema	BTMTopologyScanSchema
	Channel Parameter Access	FDTBasicChannelParameterSchema	FDTFoundationFieldbusChannelParameterSchema
H1-5	Block Information	BtmInformationSchema BtmDataTypesSchema	BTMInformationSchema
	Initialization of BTM	BtmInitSchema BtmDataTypesSchema	BTMInitSchema
	Parameter Access	BtmParameterSchema BtmDataTypesSchema	BTMParameterSchema
H1-2.3	Communication	FdtFFFmsSchema FdtFFH1CommunicationSchema FdtFFDataTypesSchema	FDTFoundationFieldbusFMSSchema FDTFoundationFieldbusH1Schema
H1-4.5	DTM-BTM Communication	FdtFFFmsSchema BTMFFCommunicationSchema BtmDataTypesSchema FdtFFDataTypesSchema	FDTFoundationFieldbusFMSSchema BtmCommunicationInstanceConnReq.xml BtmCommunicationInstanceConnResp.xml BtmCommunicationInstanceFmsReadReq.xml BtmCommunicationInstanceFmsReadResp.xml

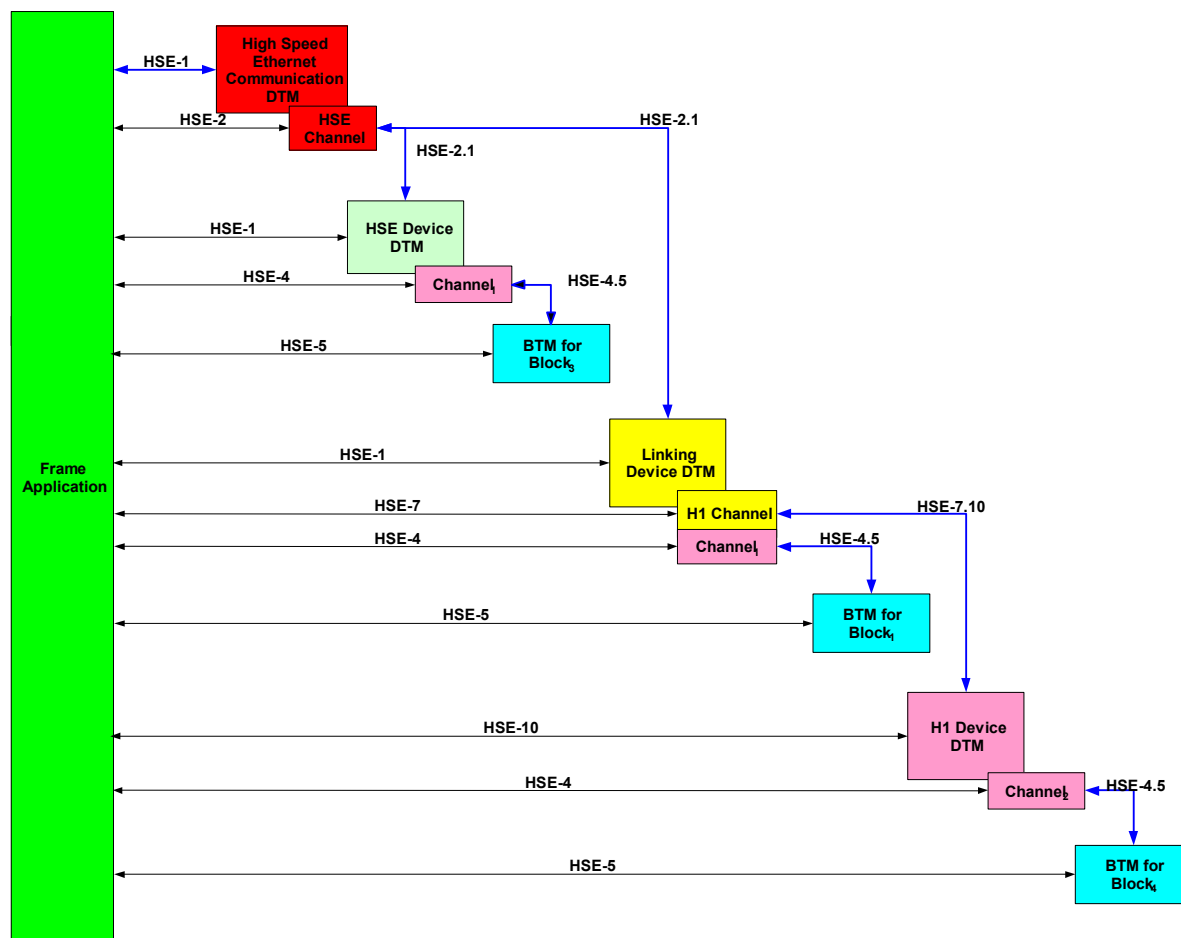


Figure 3 – Object relations for HSE DTM

In this Figure 3, blue lines show the object hierarchy as it is managed in the FDT Frame Application. The relations are explained in following Table 2.

Table 2 – Explanation of object relations for HSE DTM

Relation	Type of information	Used schemas	Examples
HSE-1	Management Parameter Access	FdtFFHSEManagementSchema	FDTFoundationFieldbusHSEManagementSchema
HSE-2	Network Topology	DtmFFSchema	DTMFoundationFieldbusDeviceSchema
	Channel Parameter Access	FdtFFChannelParameterSchema	FDTFoundationFieldbusChannelParameterSchema
HSE-2.1	Communication	FdtFFFmsSchema	FDTFoundationFieldbusFMSSchema
		FdtFFHseCommunicationSchema	FDTFoundationFieldbusHSESchema
		FdtFFDataTypesSchema	
HSE-4.5	DTM-BTM Communication	FdtFFFmsSchema	FDTFoundationFieldbusFMSSchema
		BTMFFCommunicationSchema	BtmCommunicationInstanceConnReq.xml
		FdtFFDataTypesSchema	BtmCommunicationInstanceConnResp.xml
		BtmDataTypesSchema	BtmCommunicationInstanceFmsReadReq.xml BtmCommunicationInstanceFmsReadResp.xml

Relation	Type of information	Used schemas	Examples
HSE-4	List of instantiated blocks	DtmFFSchema FdtFFBlockSchema BtmDataTypesSchema	BTMTopologyScanSchema
	Channel Parameter Access	FDTBasicChannelParameterSchema	FDTFoundationFieldbusChannelParameterSchema
HSE-5	Block Information	BtmInformationSchema BtmDataTypesSchema	BTMInformationSchema
	Initialization of BTM	BtmInitSchema BtmDataTypesSchema	BTMInitSchema
	Parameter Access	BtmParameterSchema BtmDataTypesSchema	BTMParameterSchema
HSE-7	Network Topology	DtmFFSchema FdtFFDataTypesSchema FdtFFHseCommunicationSchema FdtFFBlockSchema	DTMFoundationFieldbusDeviceSchema
	Channel Parameter Access	FdtFFChannelParameterSchema FdtFFH1ManagementSchema	FDTFoundationFieldbusChannelParameterSchema
	Parameter Access	BtmParameterSchema	BTMParameterSchema
HSE-10	Management Parameter Access	FdtFFH1ManagementSchema FdtFFDataTypesSchema	FDTFoundationFieldbusH1ManagementSchema
HSE-7.10	Communication	FdtFFFMSSchema FdtFFH1CommunicationSchema FdtFFDataTypesSchema	FDTFoundationFieldbusFMSSchema FDTFoundationFieldbusH1Schema

3.2 Unique identifier

3.2.1 Component categories

For device-specific BTMs, a bus category (CATID) must be defined for the protocol between DTM and BTM.

The bus category is used by the Frame Application to identify the device-specific blocks. The Frame Application can prevent a device-specific block from Device A being assigned to a Device B that does not support the block.

Different protocols defined by different CATIDs can use the same communication schemas.

CATID description in the registry	Symbolic name of the CATID	UUID of the CATID	Description
"FDT FF STANDARD BLOCK"	CATID_FDT_FF_STD_BLOCK	{036D1693-387B-11D4-86E1-00E0987270B9}	For FDT FF standard block protocol

The following table shows the valid combination of category ids.

Symbolic name of the CATID	CATID_FDT_DTM	CATID_FDT_DEVICE	CATID_FDT_MODULE	CATID_FDT_BTM	CATID_FDT_STD_BLOCK
CATID_FDT_BTM				√	
CATID_FDT_STD_BLOCK				√	

3.2.2 Bus category

FF protocol is identified by the following unique identifier in busCategory attributes within XML BusCategory elements.

BusCategory Element	Description
036D1691-387B-11D4-86E1-00E0987270B9	Object supports FF H1 protocol
036D1692-387B-11D4-86E1-00E0987270B9	Object supports FF HSE protocol
036D1693-387B-11D4-86E1-00E0987270B9	For FDT FF standard block protocol

4 FF communication

4.1 Connection management

FDT Connect request service establishes an FDT Connection. The FDT Connection acts as a container for FMS Connections, as a container for SM connectionless services and as a container for FDA sessions.

It is necessary to maintain the FMS Connection separate from the underlying FDT Connection.

4.1.1 FMS connection

All FMS services are modelled in FDT as Transactions in the respective protocols. This includes the services for the FMS connection management. FMSInitiate and FMSAbort manage the lifetime of a FMS connection.

In order to open multiple **FMS Connections** on the same **FDT Connection**, IFdtCommunication::TransactionRequest() is called with an FmsInitiateRequest element as argument (see Figure 4).

The communication reference passed with the FmsInitiateRequest element identifies the FDT Connection to be used. The FmsInitiateResponse element returned with IFdtCommunicationEvents::OnTransactionResponse provides a communication reference used for all further FMS services on that FMS Connection.

This allows multiple FMS connections on one FDT Connection.

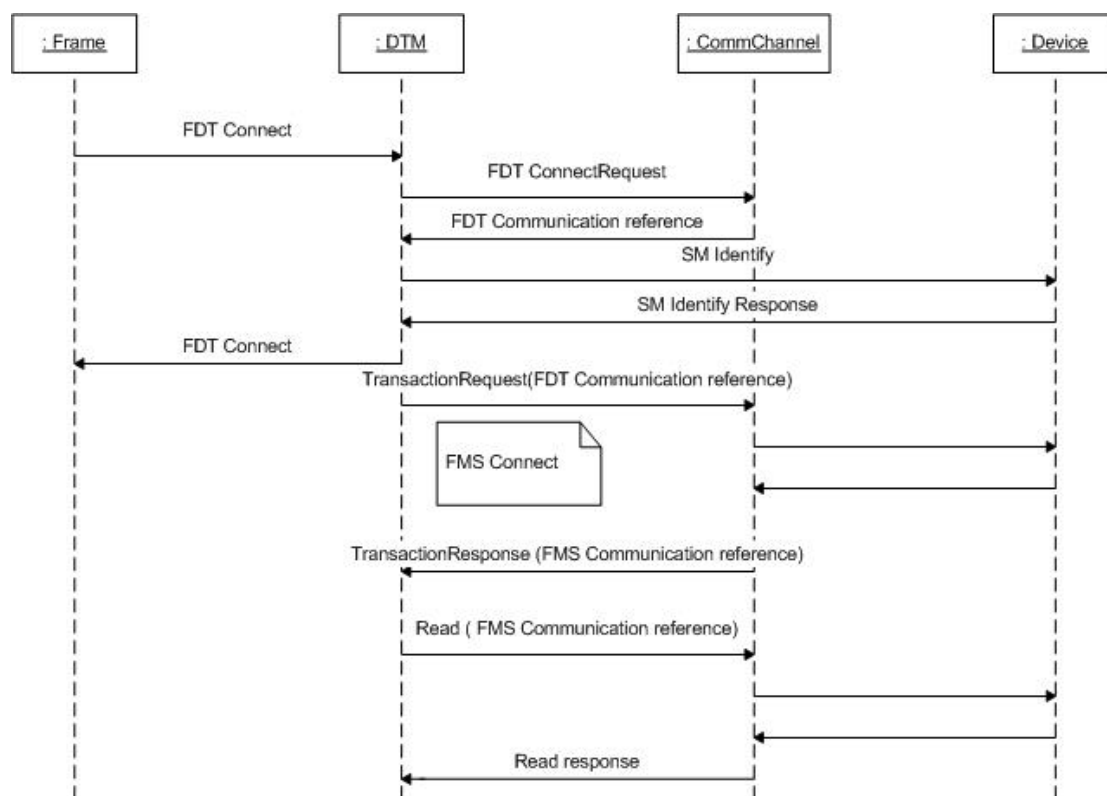


Figure 4 – Creation of an FMS connection

If the FDT connection is closed, the FMS connections for this connection are also closed automatically (by the communication channel) before the FDT Disconnect is completed (see Figure 5).

Any transactions requested after that will fail. No outstanding services will be processed.

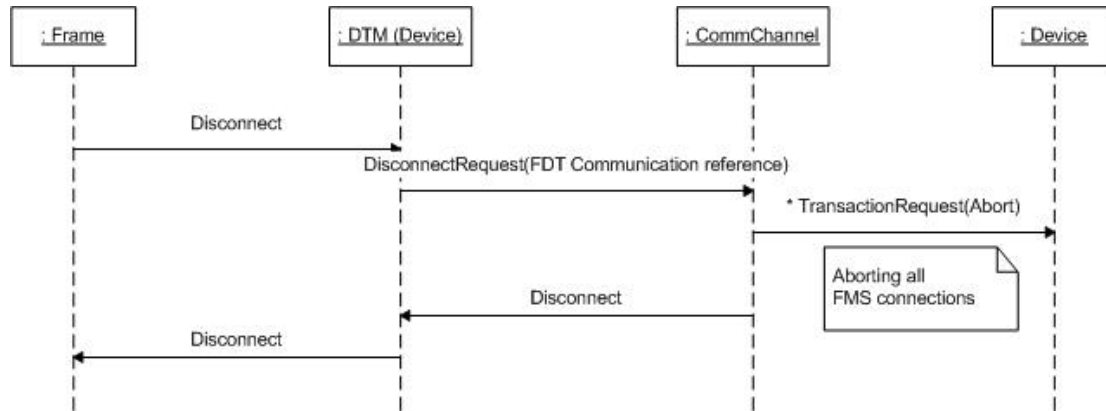


Figure 5 – Termination of an FMS connection

FMSAbort service request closes a single FMS connection.

4.1.2 HSE connection

FDT Connection is using ConnectRequest:

- To establish an FDT connection intended for System Management services only. When FDT connections for SM services only are established, the OpenSessionRequest element is not part of the ConnectRequest. Any request to establish an FMS Connection on this type of FDT Connection shall be rejected.
- To establish an FDT Connection that represents a session as described with the specification FF-588 Field Device Access Agent. FMS Connections can be established by using the FDT Communication reference returned as a result of FDT connection establishment. Note that Multicast SM services are not allowed in this Connection.

If a HSE device needs both types of connections it needs to create System management and FDT Session Connections.

When a Frame Application requests the DTM to disconnect all FMS, and FDT (SM and Session), connections will be terminated.

4.2 Abort

4.2.1 OnAbort indication

At any moment during the lifetime of the (FDT or FMS) Connection an OnAbort event indication can be received by the DTM/BTM from the Communication Channel. There can be two reasons for OnAbort Event:

- FMS Connection Abort
- FDT Connection Abort.

The Communication reference uniquely identifies the Connection to be aborted. If a FDT Connection Abort is indicated, all FMS connections of the corresponding FDT Connection must be terminated. No Abort requests are issued to the Communication Channel. All pending requests must be canceled.

If a FMS Connection Abort is indicated, only the FMS Connection identified by that Communication Reference is terminated.

4.2.2 Abort request

At any moment during the lifetime of the (FDT or FMS) Connections a DTM/BTM can issue an Abort request to the Communication Channel. There can be two types of Communication References in the Abort request:

- FMS Communication Reference
- FDT Communication Reference

The Communication reference uniquely identifies the Connection to be aborted. If an FDT Connection Abort is requested, all related FMS connections in the Communication channel must be terminated.

No separate Abort requests are issued to the Communication Channel for the individual FMS Connections. All pending requests must be canceled.

If an FMS Communication Reference is used in the Abort, only the FMS Connection identified by that Communication Reference is terminated.

4.3 Relation of FMS requests and FMS responses

If a DeviceDTM (communication client) issues a certain FMS request, it has to expect a response from a certain set (one or more) of possible responses. The following Table 3 shows what responses can be expected in regard to different FMS requests.

Table 3 – Relation of FMS requests and FMS responses

Request	Response (s)
FmsInitiateRequest	FmsInitiateResponse FmsInitiateError
FmsAbortRequest	FmsStandardResponse
FmsReadRequest	FmsReadResponse FmsServiceError
FmsWriteRequest	FmsStandardResponse FmsServiceError
FmsStatusRequest	FmsStatusResponse FmsServiceError
FmsIdentifyRequest	FmsIdentifyResponse FmsServiceError
FmsDefineVariableListRequest	FmsDefineVariableListResponse FmsServiceError
FmsDeleteVariableListRequest	FmsStandardResponse FmsServiceError
FmsGetOdRequest	FmsGetOdResponse FmsServiceError
FmsGenericInitiateDownloadSequenceRequest	FmsStandardResponse FmsServiceError
FmsGenericDownloadSegmentRequest	FmsStandardResponse FmsServiceError
FmsGenericTerminateDownloadSequence Request	FmsGenericTerminateDownloadSequenceResponse FmsServiceError

A standard FDT CommunicationError response can be received instead of FMS Transaction response to indicate a general communication error. Communication clients must be prepared to handle such response.

If the FMS connection is shared between several BTMs, all connections will receive OnAbort event.

4.4 Levels of support

Similar to the levels of support for FF devices, this PAS defines levels of support for DTMs (see Table 4).

Table 4 – Levels of support

Services	HSE				H1			
	Level 0 support	Level 1 support	Level 2 support	Level 4 support	Level 0 Support	Level 1 Support	Level 2 Support	Level 4 Support
SmSetPDTag	N/A	N/A	N/A	N/A	O	-	M	-
SmSetAddress	N/A	N/A	N/A	N/A	O	-	M	-
SmFindTag	O	-	M	-	O	-	M	-
SmIdentify	M	-	M	-	M	-	M	-
SmClearAddress	O	-	M	-	O	-	M	-
SmClearAssignmentInfo	O	-	M	-	N/A	N/A	N/A	N/A
SmSetAssignmentInfo	O	-	M	-	N/A	N/A	N/A	N/A
fms:FmsInitiate	M	M	-	-	M	M	-	-
fms:FmsAbort	M	M	-	-	M	M	-	-
fms:FmsStatus	O	M	-	-	O	M	-	-
fms:FmsIdentify	O	M	-	-	O	M	-	-
fms:FmsRead	M	M	-	-	M	M	-	-
fms:FmsWrite	M	M	-	-	M	M	-	-
fms:FmsGetOd	O	M	-	-	O	M	-	-
fms:FmsDefineVariableList	O	-	-	M	O	-	-	M
fms:FmsDeleteVariableList	O	-	-	M	O	-	-	M
fms:FmsGenericDownload	O	-	-	M	O	-	-	M
Legend: M – Mandatory O – Optional N/A - Not Applicable Level 0: Minimal Support Level 1: FMS Mandatory services support Level 2: SM Address assignment support Level 4: Download (Domain and Variable List) Services support								

FF H1 and HSE support levels for DTMs are a combination of the levels defined in Table 5. The levels in the table are defined in a way that the sum of different levels always yields a unique resulting level number.

Examples:

Mandatory Services on Level 0 will be always implemented.

A fully functional HSE DTM is level HSE-7, since it supports levels HSE-1, HSE-2, and HSE-4 additional to the basic HSE level 0.

An H1 DTM, that supports all Mandatory FMS services and also allow Address and Tag Assignment is of level H1-3, since it supports levels H1-1 and H1-2 additional to the basic H1 level 0.

SM services SetPDTag and SetAddress are H1 specific and therefore not listed in the HSE levels 0 and 2.

SM services ClearAssignmentInfo and SetAssignmentInfo are HSE specific and therefore not listed in the H1 levels 0 and 2.

5 Provided data

5.1 Interface IDtmParameter

The minimum set of provided data should be

- for foundation fieldbus devices, System Management and Network Management parameters should be provided by the DTM as specified in 4.4. "Fieldbus Management" of the FF addendum,
- all standard block parameters should be provided by the corresponding BTM object as specified in 4.2.3. "Parameter Access" of the FF addendum.

5.2 SingleDataAccess interfaces

5.2.1 DTM

All parameters exposed by the DTM to the Frame Application must be accessible by these interfaces.

5.2.2 BTM

BTMs build according to the function block specification must expose all parameters for the corresponding block. This means all parameters defined for a block in the FF specification must be exposed. The manufacturer specific parameters can extend this list. User-defined parameters must be exposed if they exist.

6 Protocol specific usage of XML attributes

The following Table 5 describes the protocol specific use of XML attributes that are defined in protocol independent schemas.

Table 5 – FF specific use of XML attributes

Attribute	Description for use in Fieldbus Foundation
address	The address attribute (defined in FDTDataTypesSchema.xml) is mandatory for the exposed parameters in the DTMs and BTMs. The address attribute string should be constructed according to the following model: VFD:xx.INDEX:yyy[.SUBINDEX:zz], where - xx is the VFD tag or index - yy is the parameter index from the beginning of the VFD - zz is the parameter subindex The numbers are integers (some can be 32-bit) and are presented as decimal digits. There should be no leading zeros for the numbers. The subindex portion of the address is optional and for parameters without subindex it can be skipped or the subindex can be set to 0.
busCategory	See 3.2.2
semanticId applicationDomain	The applicationDomain attribute is: FDT_FoundationFieldbus The semanticId for Foundation Fieldbus related parameter follows the following rules: The semanticId must be built based on the names defined in the FF specification Structured parameters must be combined with a '.' Spaces within the profile definition must be exchanged with an underscore Capital letters should be used For detailed description please refer to "4.2.3 Parameter Access" of the FF addendum. <i>Examples:</i> OUT.STATUS OUT.VALUE OUT SemanticID for FF Fieldbus management parameter: Fieldbus management parameter (well-defined with inline schemas within the element 'UserdefinedBus' of the DTMPParameterSchema) follow the following rule: 'FDT.UserDefinedBus' followed by the structure of the XML document of the inline schema. Each element must be divided by a '.'. <i>Example:</i> FDT.UserDefinedBus.ListOfH1NmaVfds.H1NmaVfd.SMIB.SmAgent.T1.t1

7 XML schemas and definitions

7.1 DTM

7.1.1 Topology scan schema

As a result of the scanning the DTM detects DTMs and objects that are covered by this Addendum. As a result of topology scan a DTM can expose information about the FF linking devices, about FF instruments and about the Blocks in the instruments.

If the DTM detects that the Frame Application supports the objects covered by this addendum it can include directly the reference to the corresponding schemas. The following files have examples demonstrating the reference to the FF schemas:

- DTMTopologyScanInstanceBlockList.xml
- DTMTopologyScanInstanceH1Device.xml

If the DTM detects that the Frame Application does not support the objects covered by this addendum the required definitions have to be defined in an inline schema. The following examples demonstrate the use of inline schemas:

- DTMTopologyScanInstanceBlockList (Inline).xml
- DTMTopologyScanInstanceH1Device (Inline).xml

The in-line schema elements must be the same as the corresponding elements from the schemas defined in this addendum.

7.1.2 DTM FF schema

The DtmFFSchema.XML file provides description information about the FF Devices.

Data types of this schema are referenced via the prefix **fdtffdevice**: within the other schemas.

Tag	Description
BlockList	Provides the list of blocks in the device
HSEDeviceInformation	HSEDeviceInformation describes High Speed Ethernet compatible devices including device version, redundancy, etc.
FoundationFieldbusH1Device	FoundationFieldbusH1Device includes information describing H1 compatible devices
FoundationFieldbusHSEDevice	Describes HSE compatible devices including the device address, VFD information, etc.

7.2 BTM

In case of a BTM the following schemas are used instead of the DTM-specific schemas defined within the FDT specification.

7.2.1 Parameter access - FF specific definitions

BTMs should use standard name attributes for standard Block parameters. The following Table 6 provides the list of the standard block parameter Mnemonic (based on Foundation Fieldbus specifications FF-890, FF-891, FF-892, FF-893, and FF-894) and their mapping to the FDT data types. The parameter mnemonic should be used as name attribute value for parameter definition.

Table 6 – List of the standard block parameter mnemonic

Parameter Mnemonic	Fieldbus Foundation Datatype/Structure	FDT Datatype (Note 1)
ACCEPT_ALM	DS-72	StructuredVariable
ACCEPT_D	Unsigned8	EnumeratorVariable
ACCEPT_PRI	Unsigned8	NumberData
ACK_OPTION	Bit String	BitEnumeratorVariable
ALARM_HYS	Float	NumberData
ALARM_SUM	DS-74	StructuredVariable
ALERT_KEY	Unsigned8	NumberData
ALGORITHM_SEL	Unsigned32	NumberData
ALM_RATE_DN	Float	NumberData
ALM_RATE_UP	Float	NumberData
ARITH_TYPE	Unsigned8	NumberData
AUTO_CYCLE	Unsigned8	EnumeratorVariable
BAL_TIME	Float	NumberData
BIAS	Float	NumberData
BIAS_IN_1	Float	NumberData
BIAS_IN_2	Float	NumberData
BIAS_IN_3	Float	NumberData
BKCAL_HYS	Float	NumberData
BKCAL_IN	DS-65	StructuredVariable
BKCAL_IN_1	DS-65	StructuredVariable
BKCAL_IN_2	DS-65	StructuredVariable
BKCAL_IN_D	DS-66	StructuredVariable
BKCAL_OUT	DS-65	StructuredVariable
BKCAL_OUT_D	DS-66	StructuredVariable
BKCAL_SEL_1	DS-65	StructuredVariable
BKCAL_SEL_2	DS-65	StructuredVariable
BKCAL_SEL_3	DS-65	StructuredVariable
BLOCK_ALM	DS-72	StructuredVariable
BLOCK_ERR	Bit String	BitEnumeratorVariable
BYPASS	Unsigned8	EnumeratorVariable
CAS_IN	DS-65	StructuredVariable
CAS_IN_D	DS-66	StructuredVariable
CFM_ACT1_TIME	Float	NumberData
CFM_ACT2_TIME	Float	NumberData
CFM_PASS_TIME	Float	NumberData
CHANNEL	Unsigned16	NumberData
CHARACTERISTICS (Note 2)	DS-64	StructuredVariable
CLOCK_PER	Float	NumberData
CLR_FSTATE	Unsigned8	EnumeratorVariable
COMB_TYPE	Unsigned8	EnumeratorVariable
COMP_HI_LIM	Float	NumberData
COMP_LO_LIM	Float	NumberData

Parameter Mnemonic	Fieldbus Foundation Datatype/Structure	FDT Datatype (Note 1)
CONFIRM_TIME	Unsigned32	NumberData
CONTENTS_REV	Unsigned32	NumberData
CONTROL_OPTS	Bit String	BitEnumeratorVariable
CRACK_TIME	Float	NumberData
CRACK_TIMER	Float	NumberData
CURVE_X	Float	NumberData
CURVE_Y	Float	NumberData
CYCLE_SEL	Bit String	BitEnumeratorVariable
CYCLE_TYPE	Bit String	BitEnumeratorVariable
DC_STATE	Unsigned8	NumberData
DD_RESOURCE	Visible String	StringData
DD_REV	Unsigned8	NumberData
DEAD_TIME	DS-65	StructuredVariable
DELAY_TIME	Float	NumberData
DELAY_TIMER	Float	NumberData
DEV_REV	Unsigned8	NumberData
DEV_TYPE	Unsigned16	NumberData
DEVICE_OPTS	Bit string	BitEnumeratorVariable
DISABLE_1	DS-66	StructuredVariable
DISABLE_2	DS-66	StructuredVariable
DISABLE_3	DS-66	StructuredVariable
DISABLE_4	DS-66	StructuredVariable
DISC_ALM	DS-72	StructuredVariable
DISC_LIM	Unsigned8	NumberData
DISC_PRI	Unsigned8	NumberData
DURATION	DURATION_TYPE (10 Floats) (Note 3)	StructuredVariable
DV_HI_ALM	DS-71	StructuredVariable
DV_HI_LIM	Float	NumberData
DV_HI_PRI	Unsigned8	NumberData
DV_LO_ALM	DS-71	StructuredVariable
DV_LO_LIM	Float	NumberData
DV_LO_PRI	Unsigned8	NumberData
EXPAND_DN	Float	NumberData
EXPAND_UP	Float	NumberData
FAIL	Unsigned16	NumberData
FAIL_ALM	DS-72	StructuredVariable
FAIL_PRI	Unsigned8	NumberData
FAULT_STATE	Unsigned8	EnumeratorVariable
FCF_LOCATOR	LOCATOR (Unsigned32 Array) (Note 4)	StructuredVariable
FDD_LOCATOR	LOCATOR (Unsigned32 Array)	StructuredVariable
FEATURE_SEL	Bit String	BitEnumeratorVariable
FEATURES	Bit String	BitEnumeratorVariable

Parameter Mnemonic	Fieldbus Foundation Datatype/Structure	FDT Datatype (Note 1)
FF_GAIN	Float	NumberData
FF_SCALE	DS-68	StructuredVariable
FF_VAL	DS-65	StructuredVariable
FIELD_VAL	DS-65	StructuredVariable
FIELD_VAL_D	DS-66	StructuredVariable
FILE_LOCATOR	LOCATOR (Unsigned32 Array)	StructuredVariable
FILE_REV	Unsigned32	NumberData
FOLLOW	DS-66	StructuredVariable
FREE_SPACE	Float	NumberData
FREE_TIME	Float	NumberData
FSTATE_STATUS	Unsigned8	NumberData
FSTATE_TIME	Float	NumberData
FSTATE_VAL	Float	NumberData
FSTATE_VAL_D	Unsigned8	NumberData
FSTATE_VAL_D1	Unsigned8	NumberData
FSTATE_VAL_D2	Unsigned8	NumberData
FSTATE_VAL_D3	Unsigned8	NumberData
FSTATE_VAL_D4	Unsigned8	NumberData
FSTATE_VAL_D5	Unsigned8	NumberData
FSTATE_VAL_D6	Unsigned8	NumberData
FSTATE_VAL_D7	Unsigned8	NumberData
FSTATE_VAL_D8	Unsigned8	NumberData
FSTATE_VAL1	Float	NumberData
FSTATE_VAL2	Float	NumberData
FSTATE_VAL3	Float	NumberData
FSTATE_VAL4	Float	NumberData
FSTATE_VAL5	Float	NumberData
FSTATE_VAL6	Float	NumberData
FSTATE_VAL7	Float	NumberData
FSTATE_VAL8	Float	NumberData
GAIN	Float	NumberData
GAIN_IN_1	Float	NumberData
GAIN_IN_2	Float	NumberData
GAIN_IN_3	Float	NumberData
GOOD_LIM	Float	NumberData
GRANT_DENY	DS-70	StructuredVariable
HARD_TYPES	Bit String	BitEnumeratorVariable
HI_ALM	DS-71	StructuredVariable
HI_BIAS	Float	NumberData
HI_GAIN	Float	NumberData
HI_HI_ALM	DS-71	StructuredVariable
HI_HI_BIAS	Float	NumberData
HI_HI_LIM	Float	NumberData

Parameter Mnemonic	Fieldbus Foundation Datatype/Structure	FDT Datatype (Note 1)
HI_HI_LIMX	Float	NumberData
HI_HI_PRI	Unsigned8	NumberData
HI_LIM	Float	NumberData
HI_LIMX	Float	NumberData
HI_PRI	Unsigned8	NumberData
HYSTVAL	Float	NumberData
IGNORE	Bit String	BitEnumeratorVariable
IGNORE_ALM	DS-72	StructuredVariable
IGNORE_PRI	Unsigned8	NumberData
IGNORE_TIME	Float	NumberData
IN	DS-65	StructuredVariable
IN_1	DS-65	StructuredVariable
IN_2	DS-65	StructuredVariable
IN_3	DS-65	StructuredVariable
IN_4	DS-65	StructuredVariable
IN_5	DS-65	StructuredVariable
IN_6	DS-65	StructuredVariable
IN_7	DS-65	StructuredVariable
IN_8	DS-65	StructuredVariable
IN_ARRAY	Float	NumberData
IN_D	DS-66	StructuredVariable
IN_D1	DS-66	StructuredVariable
IN_D2	DS-66	StructuredVariable
IN_D3	DS-66	StructuredVariable
IN_D4	DS-66	StructuredVariable
IN_LO	DS-65	StructuredVariable
INPUT_OPTS	Bit String	BitEnumeratorVariable
INTEG_OPTS	Bit String	BitEnumeratorVariable
INTEG_TYPE	Unsigned8	NumberData
INTERLOCK_D	DS-66	StructuredVariable
INVERT_OPTS	Bit String	BitEnumeratorVariable
IO_OPTS	Bit String	BitEnumeratorVariable
ITK_VER	Unsigned16	NumberData
L_TYPE	Unsigned8	EnumeratorVariable
LAG_TIME	Float	NumberData
LEAD_TIME	Float	NumberData
LIM_NOTIFY	Unsigned8	NumberData
LO_ALM	DS-71	StructuredVariable
LO_BIAS	Float	NumberData
LO_GAIN	Float	NumberData
LO_LIM	Float	NumberData
LO_LIMX	Float	NumberData
LO_LO_ALM	DS-71	StructuredVariable

Parameter Mnemonic	Fieldbus Foundation Datatype/Structure	FDT Datatype (Note 1)
LO_LO_BIAS	Float	NumberData
LO_LO_LIM	Float	NumberData
LO_LO_LIMX	Float	NumberData
LO_LO_PRI	Unsigned8	NumberData
LO_PRI	Unsigned8	NumberData
LOCKVAL	Unsigned8	EnumeratorVariable
LOW_CUT	Float	NumberData
MANUFAC_ID	Unsigned32	NumberData
MAX_NOTIFY	Unsigned8	NumberData
MEMORY_SIZE	Unsigned16	NumberData
MIN_CYCLE_T	Unsigned32	NumberData
MIN_GOOD	Unsigned8	NumberData
MO_OPTS	Bit String	BitEnumeratorVariable
MODE_BLK	DS-69	StructuredVariable
N_RESET	Float	NumberData
N_START	Unsigned16	NumberData
NV_CYCLE_T	Unsigned32	NumberData
OP_CMD_INT	Unsigned8	EnumeratorVariable
OP_CMD_SPG	Unsigned8	EnumeratorVariable
OP_SELECT	DS-66	StructuredVariable
OUT	DS-65	StructuredVariable
OUT_1	DS-65	StructuredVariable
OUT_1_RANGE	DS-68	StructuredVariable
OUT_2	DS-65	StructuredVariable
OUT_2_RANGE	DS-68	StructuredVariable
OUT_3	DS-65	StructuredVariable
OUT_4	DS-65	StructuredVariable
OUT_5	DS-65	StructuredVariable
OUT_6	DS-65	StructuredVariable
OUT_7	DS-65	StructuredVariable
OUT_8	DS-65	StructuredVariable
OUT_ALM	DS-66	StructuredVariable
OUT_ALM_SUM	Unsigned8	EnumeratorVariable
OUT_ARRAY	Float	NumberData
OUT_D	DS-66	StructuredVariable
OUT_D5	DS-66	StructuredVariable
OUT_D6	DS-66	StructuredVariable
OUT_D7	DS-66	StructuredVariable
OUT_D8	DS-66	StructuredVariable
OUT_EXP	DS-65	StructuredVariable
OUT_HI_LIM	Float	NumberData
OUT_LO_LIM	Float	NumberData
OUT_PTRIP	DS-66	StructuredVariable