Field device tool (FDT) interface specification - Part 2: Concepts and detailed description

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 62453-2:2009 sisaldab Euroopa standardi EN 62453-2:2009 ingliskeelset teksti.	This Estonian standard EVS-EN 62453-2:2009 consists of the English text of the European standard EN 62453-2:2009.
Standard on kinnitatud Eesti Standardikeskuse 31.12.2009 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 31.12.2009 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 15.10.2009.	Date of Availability of the European standard text 15.10.2009.
Standard on kättesaadav Eesti standardiorganisatsioonist.	The standard is available from Estonian standardisation organisation.

ICS 33.040

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62453-2

October 2009

ICS 25.040.40; 35.100.05; 35.110

English version

Field device tool (FDT) interface specification - Part 2: Concepts and detailed description

(IEC 62453-2:2009)

Spécification des interfaces des outils des dispositifs de terrain (FDT) - Partie 2: Concepts et description détaillée (CEI 62453-2:2009)

Field Device Tool (FDT)- Schnittstellenspezifikation - Teil 2: Konzept und grundlegende Beschreibung (IEC 62453-2:2009)

This European Standard was approved by CENELEC on 2009-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 62453-2:2009 E

Foreword

The text of document 65E/124/FDIS, future edition 1 of IEC 62453-2, prepared by SC 65E, Devices and integration in enterprise systems, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62453-2 on 2009-08-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-05-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-08-01

Annex ZA has been added by CENELEC.

_____

Endorsement notice

The text of the International Standard IEC 62453-2:2009 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 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.

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

Publication	Year	Title	EN/HD	Year
IEC 61131	Series	Programmable controllers	EN 61131	Series
IEC/TR 62390	2005	Common automation device - Profile guideline	–	–
IEC 62453-1	2009	Field device tool (FDT) interface specification - Part 1: Overview and guidance	EN 62453-1	2009
IEC 62453-3xy	Series	Field device tool (FDT) interface specification - Part 3xy: Communication profile integration	EN 62453-3xy	Series
IEC/TR 62453-41	2009	Field device tool interface specification - Part 41: Object model integration profile - Common object model	CLC/TR 62453-41	2009
ISO/IEC 19501	2005	Information technology - Open Distributed Processing - Unified Modeling Language (UML)	–	–

CONTENTS

FOREWORD 10
INTRODUCTION 12
1 Scope 13
2 Normative references 13
3 Terms, definitions, symbols, abbreviated terms and conventions 13
3.1 Terms and definitions 13
3.2 Symbols and abbreviated terms 14
3.3 Conventions 14
3.3.1 State availability statement 14
3.3.2 Data type names and references to data types 14
4 Fundamentals 14
4.1 General 14
4.2 Abstract FDT model 14
4.2.1 FDT model overview 14
4.2.2 Frame Application (FA) 18
4.2.3 Device Type Manager (DTM) 18
4.2.4 Presentation object 22
4.2.5 Channel object 23
4.3 Modularity 24
4.4 Bus categories 25
4.5 System and FDT topology 25
4.6 Peer to peer and nested communication 27
4.7 DTM, DTM Device Type and Hardware Identification Information 28
4.7.1 DTM and DTM Device Type 28
4.7.2 Supported hardware identification 29
4.7.3 Connected Hardware Identification 30
4.8 DTM data persistence and synchronization 30
4.9 DTM device parameter access 31
4.10 DTM state machine 32
4.10.1 DTM states 32
4.10.2 ‘Communication allowed’ sub-states 33
4.11 Basic operation phases 34
4.11.1 Roles and access rights 34
4.11.2 Operation phases 34
4.12 FDT version interoperability 35
4.12.1 Version interoperability overview 35
4.12.2 DTM and device versions 36
4.12.3 Persistence 36
4.12.4 Nested communication 36
5 FDT session model and use cases 37
5.1 Session model overview 37
5.2 Actors 38
5.3 Use cases 40
5.3.1 Use case overview 40
5.3.2 Observation 40
5.3.3 Operation 40

5.3.4 Maintenance 44
5.3.5 Planning 48
5.3.6 OEM service 51
5.3.7 Administration 52
6 General concepts 53
6.1 Address management 53
6.2 Scanning and DTM assignment 53
6.2.1 Scanning introduction 53
6.2.2 Scanning 54
6.2.3 DTM assignment 54
6.2.4 Manufacturer specific device identification 54
6.2.5 Scan for communication hardware 55
6.3 Configuration of fieldbus master or communication scheduler 55
6.4 Slave redundancy 56
6.4.1 Redundancy overview 56
6.4.2 Redundancy support in Frame Application 57
6.4.3 Parent component for redundant fieldbus 58
6.4.4 Redundancy support in Device DTM 58
6.4.5 Scan and redundant slaves 59
7 FDT service specification 59
7.1 Service specification overview 59
7.2 DTM services 60
7.2.1 General services 60
7.2.2 DTM services related to installation 62
7.2.3 DTM services related to DTM/device information 62
7.2.4 DTM services related to the DTM state machine 64
7.2.5 DTM services related to functions 67
7.2.6 DTM services related to channel objects 69
7.2.7 DTM services related to documentation 70
7.2.8 DTM services to access the instance data 70
7.2.9 DTM services to evaluate the instance data 71
7.2.10 DTM services to access the device data 72
7.2.11 DTM services related to network management information 74
7.2.12 DTM services related to online operation 74
7.2.13 DTM services related to data synchronization 76
7.2.14 DTM services related to import and export 78
7.3 Presentation object services 78
7.4 Channel object service 78
7.4.1 Channel object service introduction 78
7.4.2 Service ReadChannelInformation 78
7.4.3 Service WriteChannelInformation 79
7.5 Process Channel object services 79
7.5.1 Services for IO related information 79
7.6 Communication Channel object services 80
7.6.1 Services related to communication 80
7.6.2 Services related to sub-topology management 84
7.6.3 Services related to GUI and functions 86
7.6.4 Services related to scan 87
7.7 Frame Application services 87

7.7.1 General state availability 87
7.7.2 FA services related to general events 87
7.7.3 FA services related to topology management 89
7.7.4 FA services related to redundancy 91
7.7.5 FA services related to storage of DTM data 92
7.7.6 FA services related to DTM data synchronization 93
7.7.7 FA services related to presentation 94
7.7.8 FA Services related to audit trail 96
8 FDT dynamic behavior 96
8.1 Generate FDT topology 96
8.1.1 FDT topology generation triggered by the Frame Application 96
8.1.2 FDT topology generation triggered by the DTM 97
8.2 Address setting 98
8.2.1 Address setting introduction 98
8.2.2 Set or modify device address – with user interface 98
8.2.3 Set or modify device address – without user interface 98
8.2.4 Display or modify all child device addresses with user interface 99
8.3 Communication 100
8.3.1 Communication overview 100
8.3.2 Peer to peer communication 100
8.3.3 Nested communication 100
8.3.4 Device initiated data transfer 101
8.4 Scanning and DTM assignment 102
8.5 Multi-user scenarios 103
8.5.1 General 103
8.5.2 Synchronized and non-synchronized locking mechanism for DTMs 105
8.5.3 Additional rules 107
8.6 Notification of changes 107
8.7 DTM instance data state machines 107
8.7.1 Instance data set introduction 107
8.7.2 Modifications state machine 108
8.7.3 Persistence state machine 109
8.7.4 Modification in device 109
8.7.5 Storage life cycle 110
8.8 Parent component handling redundant slave 111
8.9 DTM upgrade 112
8.9.1 General rules 112
8.9.2 Saving data from a DTM to be upgraded 113
8.9.3 Loading data in the replacement DTM 113
Annex A (normative) FDT data types definition 115

Figure 1 – Part 2 of the IEC 62453 series 12
Figure 2 – Abstract FDT model 15
Figure 3 – Frame Application with integrated Communication Channel 18
Figure 4 – Device Type Manager (DTM) 19
Figure 5 – Communication DTM 19
Figure 6 – Device DTM 20
Figure 7 – Gateway DTM 20

Figure 8 – Module DTM 21
Figure 9 – Block Type Manager (BTM) 22
Figure 10 – Presentation object 22
Figure 11 – Channel object 23
Figure 12 – Combined Process / Communication Channel 24
Figure 13 – FDT topology for a simple system topology 25
Figure 14 – FDT topology for a complex system topology 26
Figure 15 – Peer to peer communication 27
Figure 16 – Nested communication 28
Figure 17 – DTM, DTM Device Type and Device Identification Information 29
Figure 18 – Connected Hardware Identification 30
Figure 19 – FDT storage and synchronization mechanisms 31
Figure 20 – DTM state machine 32
Figure 21 – Substates of communication allowed 33
Figure 22 – Main Use Case Diagram 38
Figure 23 – Observation Use Cases 40
Figure 24 – Operation Use Cases 41
Figure 25 – Maintenance use cases 44
Figure 26 – Planning use cases 49
Figure 27 – OEM service 51
Figure 28 – Administrator use cases 52
Figure 29 – Address setting via DTM presentation object 53
Figure 30 – Fieldbus scanning 54
Figure 31 – Fieldbus master configuration tool as part of a DTM 56
Figure 32 – Redundancy scenarios 57
Figure 33 – FDT topology generation triggered by the Frame Applications 97
Figure 34 – FDT topology generation triggered by a DTM 97
Figure 35 – Set or modify device address – with user interface 98
Figure 36 – Set or modify device address – with user interface 99
Figure 37 – Set or modify all device addresses – with user interface 99
Figure 38 – Peer to peer communication 100
Figure 39 – Nested communication 101
Figure 40 – Device initiated data transfer 102
Figure 41 – Scanning and DTM assignment 103
Figure 42 – Multi-user system 104
Figure 43 – General synchronized locking mechanism 105
Figure 44 – General non-synchronized locking mechanism 106
Figure 45 – Parameterization in case of synchronized locking mechanism 106
Figure 46 – Modifications state machine of instance data 108
Figure 47 – Persistence state machine of instance data 109
Figure 48 – Management of redundant topology 112
Figure 49 – Associating data to a dataSetId 113
Figure 50 – Loading data for a supported dataSetId 114

Table 1 – Description of FDT objects 15
Table 2 – Description of associations between FDT objects 16
Table 3 – Transitions of DTM states 33
Table 4 – Transitions of DTM ‘communication allowed’ sub states 33
Table 5 – Operation phases 35
Table 6 – Actors 39
Table 7 – Operation Use Cases 41
Table 8 – Maintenance use cases 45
Table 9 – Planning use cases 49
Table 10 – Administrator use cases 52
Table 11 – Arguments for service PrivateDialogEnabled 60
Table 12 – Arguments for service SetLanguage 61
Table 13 – Arguments for service SetSystemGuiLabel 61
Table 14 – Arguments for service GetTypeInformation (for DTM) 62
Table 15 – Arguments for service GetTypeInformation (for BTM) 62
Table 16 – Arguments for service GetIdentificationInformation (for DTM) 63
Table 17 – Arguments for service GetIdentificationInformation (for BTM) 63
Table 18 – Arguments for service Hardware information (for DTM) 63
Table 19 – Arguments for service GetActiveTypeInfo 64
Table 20 – Arguments for service GetActiveTypeInfo (for BTM) 64
Table 21 – Arguments for service Initialize (for DTM) 64
Table 22 – Arguments for service Initialize (for BTM) 65
Table 23 – Arguments for service SetLinkedCommunicationChannel 65
Table 24 – Arguments for service EnableCommunication 65
Table 25 – Arguments for service ReleaseLinkedCommunicationChannel 66
Table 26 – Arguments for service ClearInstanceData 66
Table 27 – Arguments for service Terminate 66
Table 28 – Arguments for service GetFunctions 67
Table 29 – Arguments for service InvokeFunctions 68
Table 30 – Arguments for service GetGuiInformation 68
Table 31 – Arguments for service OpenPresentation 68
Table 32 – Arguments for service ClosePresentation 69
Table 33 – Arguments for service GetChannels 69
Table 34 – Arguments for service GetDocumentation 70
Table 35 – Arguments for service InstanceDataInformation 70
Table 36 – Arguments for service InstanceDataRead 71
Table 37 – Arguments for service InstanceDataWrite 71
Table 38 – Arguments for service Verify 71
Table 39 – Arguments for service CompareDataValueSets 72
Table 40 – Arguments for service DeviceDataInformation 72
Table 41 – Arguments for service DeviceDataRead 73
Table 42 – Arguments for service DeviceDataWrite 73

Table 43 – Arguments for service NetworkManagementInfoRead 74
Table 44 – Arguments for service NetworkManagementInfoWrite 74
Table 45 – Arguments for service DeviceStatus (for DTM) 74
Table 46 – Arguments for service CompareInstanceDataWithDeviceData (for DTM) 75
Table 47 – Arguments for service WriteDataToDevice (for DTM) 75
Table 48 – Arguments for service ReadDataFromDevice(for DTM) 76
Table 49 – Arguments for service OnLockInstanceData 76
Table 50 – Arguments for service OnUnlockInstanceData 76
Table 51 – Arguments for service OnInstanceDataChanged 77
Table 52 – Arguments for service OnInstanceChildDataChanged 77
Table 53 – Arguments for service Export 78
Table 54 – Arguments for service Import 78
Table 55 – Arguments for service ReadChannelInformation 79
Table 56 – Arguments for service WriteChannelInformation 79
Table 57 – Arguments for service ReadChannelData 79
Table 58 – Arguments for service WriteChannelData 80
Table 59 – Arguments for service GetSupportedProtocols 80
Table 60 – Arguments for service Connect 81
Table 61 – Arguments for service Disconnect 81
Table 62 – Arguments for service AbortRequest 82
Table 63 – Arguments for service AbortIndication 82
Table 64 – Arguments for service Transaction 82
Table 65 – Arguments for service SequenceDefine 83
Table 66 – Arguments for service SequenceStart 83
Table 67 – Arguments for service ValidateAddChild 84
Table 68 – Arguments for service ChildAdded 84
Table 69 – Arguments for service ValidateRemoveChild 85
Table 70 – Arguments for service ChildRemoved 85
Table 71 – Arguments for service SetChildrenAddresses 85
Table 72 – Arguments for service GetChannelFunctions 86
Table 73 – Arguments for service GetGuiInformation 86
Table 74 – Arguments for service Scan 87
Table 75 – Arguments for service OnErrorMessage 87
Table 76 – Arguments for service OnProgress 88
Table 77 – Arguments for service OnOnlineStatusChanged 88
Table 78 – Arguments for service OnFunctionsChanged 88
Table 79 – Arguments for service GetDtmInfoList 89
Table 80 – Arguments for service CreateChild (DTM) 89
Table 81 – Arguments for service CreateChild (BTM) 89
Table 82 – Arguments for service DeleteChild 90
Table 83 – Arguments for service MoveChild 90
Table 84 – Arguments for service GetParentNodes 90
Table 85 – Arguments for service GetChildNodes 91

Table 86 – Arguments for service GetDtm 91
Table 87 – Arguments for service ReleaseDtm 91
Table 88 – Arguments for service OnAddedRedundantChild 92
Table 89 – Arguments for service OnRemovedRedundantChild 92
Table 90 – Arguments for service SaveInstanceData 92
Table 91 – Arguments for service LoadInstanceData 93
Table 92 – Arguments for service GetPrivateDtmStorageInformation 93
Table 93 – Arguments for service LockInstanceData 93
Table 94 – Arguments for service UnlockInstanceData 94
Table 95 – Arguments for service OnInstanceDataChanged 94
Table 96 – Arguments for service OpenPresentationRequest 94
Table 97 – Arguments for service ClosePresentationRequest 95
Table 98 – Arguments for service UserDialog 95
Table 99 – Arguments for service RecordAuditTrailEvent 96
Table 100 – Modifications state machine of instance data 108
Table 101 – Persistence state machine of instance data 109
Table 102 – Example life cycle of a DTM 110
Table A.1 – Basic data types 116
Table A.2 – Simple general data types 116
Table A.3 – Definition of classificationId enumeration values 123
Table A.4 – General structured data types 124
Table A.5 – Simple user information data types 133
Table A.6 – Structured user information data type 133
Table A.7 – Structured DTM information data type 133
Table A.8 – Simple BTM data types 134
Table A.9 – Structured BTM data types 134
Table A.10 – Simple device identification data types 136
Table A.11 – Structured device identification data types 137
Table A.12 – Simple function data types 139
Table A.13 – Structured function data types 140
Table A.14 – Simple auditTrail data types 142
Table A.15 – Structured auditTrail data types 142
Table A.16 – Simple documentation data types 143
Table A.17 – Structured documentation data types 143
Table A.18 – Simple deviceList data type 145
Table A.19 – Structured deviceList data type 145
Table A.20 – Simple network management data types 146
Table A.21 – Structured network management data types 146
Table A.22 – Simple instance data types 147
Table A.23 – Structured instance data types 149
Table A.24 – Simple device status data types 151
Table A.25 – Structured device status data types 152
Table A.26 – Simple online compare data types 152

Table A.27 – Structured online compare data types 152
Table A.28 – Simple user interface data types 153
Table A.29 – Structured user interface data types 153
Table A.30 – Fieldbus data types 154

INTRODUCTION

This part of IEC 62453 is an interface specification for developers of FDT (Field Device Tool) 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 fieldbusses 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 created according to this standard is called Device Type Manager (DTM). It integrates all device–specific data, functions and business rules into the system via the FDT services defined herein.

The FDT/DTM approach is open for all kind of fieldbusses and enables integration variety of devices into heterogeneous systems.

Figure 1 shows how IEC 62453-2 is aligned in the structure of the IEC 62453 series.

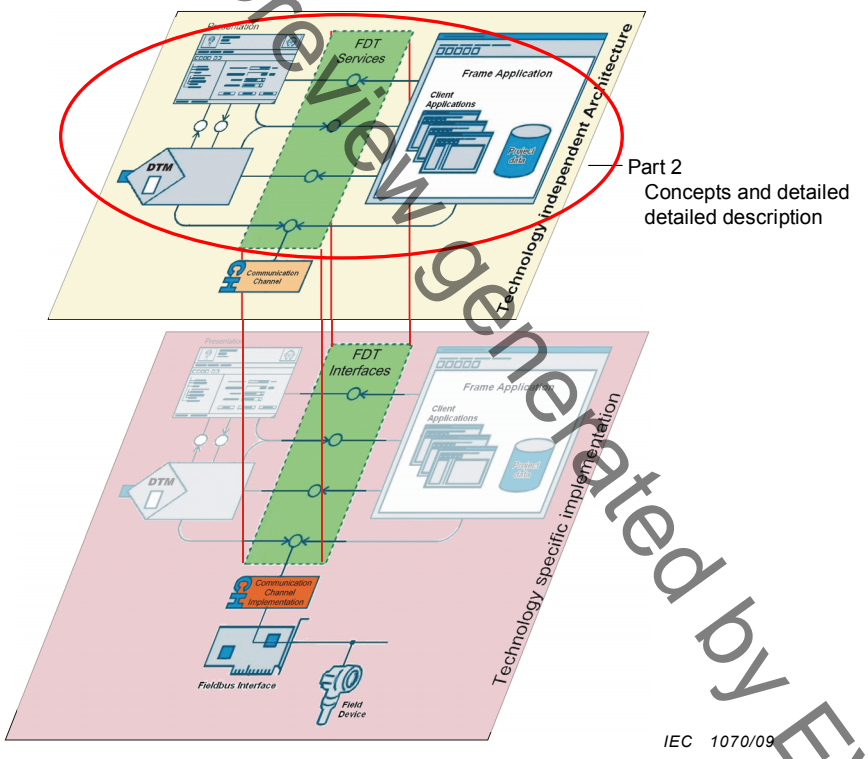

Figure 1 – Part 2 of the IEC 62453 series

FIELD DEVICE TOOL (FDT) INTERFACE SPECIFICATION –

Part 2: Concepts and detailed description

1 Scope

This part of IEC 62453 explains the common principles of the field device tool concept. These principles can be used in various industrial applications such as engineering systems, configuration programs and monitoring and diagnostic applications.

This standard specifies the general objects, general object behavior and general object interactions that provide the base of FDT.

2 Normative references

The following referenced documents are indispensable for the application of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61131 (all parts), *Programmable controllers*

IEC/TR 62390, *Common automation device – Profile guideline*

IEC 62453-1:2009, *Field Device Tool (FDT) interface specification – Part 1: Overview and guidance*

IEC 62453-3xy (all parts):2009, *Field Device Tool (FDT) interface specification – Part 3xy: Communication profile integration*

IEC/TR 62453-41:2009, *Field Device Tool (FDT) interface specification – Part 41: Object model integration profile – Common object model*

ISO/IEC 19501:2005, *Information technology – Open Distributed Processing – Unified Modeling Language (UML)* Version 1.4.2

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 and the following apply.

3.1.1
FDT version
implementation version defined by the related technology specific organization

NOTE The FDT version is specified in IEC/TR 62453-41.

3.1.2
monolithic DTM
is one single DTM that represents the complete device with all its modules