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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Field device integration (FDI)® – Part 151-1: Profiles – OPC UA

Intégration des appareils de terrain (FDI)® – Partie 151-1: Profils – OPC UA

IEC 62769-151-1:2023-04(en-fr)

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FIELD DEVICE INTEGRATION (FDI®) –

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FOREWORD

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The text of this International Standard is based on the following documents:

Draft	Report on voting
65E/853/CDV	65E/911/RVC

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 International Standard is English.

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/publications.

A list of all parts in the IEC 62769 series, published under the general title *Field device integration (FDI®)*, 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

FIELD DEVICE INTEGRATION (FDI®) –

Part 151-1: Profiles – OPC UA

1 Scope

This part of IEC 62769 defines the protocol-specific definitions (PSDs) as defined in IEC 62769-7 for the OPC UA protocol.

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

IEC 61804 (all parts), *Devices and integration in enterprise systems – Function blocks (FB) for process control and electronic device description language (EDDL)*

IEC 62541-4:2020, *OPC unified architecture – Part 4: Services*

IEC 62541-6:2020, *OPC Unified Architecture – Part 6: Mappings*

IEC 62541-12:2020, *OPC unified architecture – Part 12: Discovery and global services*

IEC 62541-100, *OPC unified architecture – Part 100: Device Interface*

IEC 62769-4, *Field device integration (FDI®) – Part 4: FDI® Packages*

IEC 62769-5, *Field device integration (FDI®) – Part 5: Information Model*

IEC 62769-7, *Field device integration (FDI®) – Part 7: Communication devices*

IEC 62769-100:2020, *Field device integration (FDI®) – Part 100: Profiles – Generic protocols*

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions are given in IEC 61784-1, IEC 61804 (all parts), IEC 62541-4, IEC 62541-100, IEC 62769-4, IEC 62769-5, and IEC 62769-7 apply.

ISO and IEC maintain terminology 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 Abbreviated terms and acronyms

For the purposes of this specification, the following abbreviations apply.

EDD	Electronic Device Description
EDDL	Electronic Device Description Language (see IEC 61804 (all parts))
FDI®[1]	Field Device Integration
FCG	FieldComm Group
XML	Extensible markup language (see REC-xml-20081126)
OPC UA	Open Platform Communications Unified Architecture
GDS	Global Discovery Server
LDS	Local Discovery Server
LDS-ME	Local Discovery Server – Multicast Extentions

4 Conventions

4.1 EDDL syntax

This document specifies content for the EDD component that is part of FDI® Communication Packages. The specification content using EDDL syntax uses the font `Courier New`. The EDDL syntax is used for method signature, variable, data structure and component declarations.

4.2 Capitalizations

The IEC 62769 series uses capitalized terms to emphasize that these terms have a FDI® specific meaning.

Some of these terms using an acronym as a prefix for example

- FDI® Client, or
- FDI® Server.

Some of these terms are compound terms such as:

- Communication Servers, or
- Profile Package.

Parameter names or attributes are concatenated to a single term, where the original terms start in this term with a capital letter such as:

- ProtocolSupportFile or
- ProtocolType.

Parameter names or attributes can also be constructed by using an underscore character to concatenate two or more terms such as:

- DEVICE_REV or
- DEVICE_MODEL

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[1] FDI is a registered trademark of the non-profit organization Fieldbus Foundation, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

5 PSDs for OPC UA

5.1 General

Clause 5 defines the protocol-specific definitions for OPC UA to be used to develop the communication server which defines header syntax, Topology Scan result mapping, error coding mapping etc.

5.2 Header

5.2.1 General

The HEADER string is composed of Service Code, NodeId, NodePath, AttributeId, and IndexRange.

Syntax:- "SERVICE_CODE=\"<code>\" NODEID=\"<NodeID>\" NODEPATH=\"<NodePath>\" ATTRIBUTE=\"<AttributeId>\" INDEXRANGE=\"<IndexRange>\""[2]

5.2.2 Service Code

Table 1 defines the supported services.

Table 1 – Service Codes

Service Code	Description
Read	Service is to perform to read the parameter value from the OPC UA device.
Write	Service is to perform to write the parameter value to the OPC UA device.
MethodCall	Service is to perform the simple Method execution supports in OPC UA device that can be invoked. A simple method is a method that doesn't have any input or output parameters. [Ex:- LoadDefaultConfiguration()]

5.2.3 NodeId

NodeId is the String representation of the target NodeId for the service. If NODEPATH is specifiied, the NodeId of the starting node of the NodePath is specified. If NODEPATH is not specifiied or null, the NodeId of the target node is specified.

Syntax:- ns=<Name Space Index>;<NodeId Type>=<Id>

NameSpace Index: Name Space Index number. For zero, ns=0 is not required.

NodeId Type:
- i UInteger
- s String
- g GUID
- b ByteString

Id: Identifier
Examples:
- ns=2;s=Temperature
- i=2045
- ns=1;g=09087e75-8e5e-499b-954f-f2a9603db28a
- ns=1;b=M/RbKBsRVkePCePcx24oRA=='

[2] Note that \ is used as escape character allowing " in the HEADER string.

5.2.4 NodePath

Nodepath is the relative path of the node starting from the specified NodeId.

The text format for the NodePath is as defined in IEC 62541-4:2020, Clause A.2]

Examples:

Browse Path	Description
“/2:Block&.Output”	Follows any forward hierarchical *Reference* with target *BrowseName* = “2:Block.Output”.
“/3:Truck.0:NodeVersion”	Follows any forward hierarchical *Reference* with target *BrowseName* = “3:Truck” and from there a forward *Aggregates Reference* to a target with *BrowseName* “0:NodeVersion”.
“<1:ConnectedTo>1:Boiler/1:HeatSensor”	Follows any forward Reference with a *BrowseName* = ‘1:ConnectedTo’ and finds targets with *BrowseName* = ‘1:Boiler’. From there follows any hierarchical *Reference* and find targets with *BrowseName* = ‘1:HeatSensor’.
“<1:ConnectedTo>1:Boiler/”	Follows any forward Reference with a *BrowseName* = ‘1:ConnectedTo’ and finds targets with *BrowseName* = ‘1:Boiler’. From there it finds all targets of hierarchical *References*.
“<0:HasChild>2:Wheel”	Follows any forward Reference with a *BrowseName* = ‘HasChild’ and qualified with the default OPC UA namespace. Then find targets with *BrowseName* = ‘Wheel’ qualified with namespace index ‘2’.
“<!HasChild>Truck”	Follows any inverse Reference with a *BrowseName* = ‘HasChild’. Then find targets with *BrowseName* = ‘Truck’. In both cases, the namespace component of the *BrowseName* is assumed to be 0.
“<0:HasChild>”	Finds all targets of forward *References* with a *BrowseName* = ‘HasChild’ and qualified with the default OPC UA namespace.

5.2.5 AttributeId

AttributeId is the Id of the attribute as defined in IEC 62541-6:2020, Clause A.1. If ATTRIBUTE is not specified, AttributeId(Value) 13 ia assumed.

5.2.6 IndexRange

IndexRange is the NumericRange as defined in IEC 62541-4:2020, 7.22. This parameter is used to identify a single element of an array, or a single range of indexes for arrays. If ATTRIBUTE is an array, and INDEXRANGE is specified, the specific element of the array is addressed. If ATTRIBUTE is an array and INDEXRANGE is not specified, all the element of the array are addressed.

Table 2 specifies the common OPC UA SERVICE_CODE values, the usage of the attributes, and the used EDD COMMAND OPERATION.

Table 2 – OPC UA Services and their representation in an EDD HEADER

Functionality	SERVICE_CODE(Hex)	NODEID	NODEPATH	ATTRIBUTE	INDEXRANGE	Operation (in EDD)	Request (in EDD)	Response (in EDD)
Read	01	NodeId of the source / start Node	Relative path of the source node	AttributeId	Index Range	R	-	Attribute Values
Write	02	NodeId of the target / start Node	Relative path of the target node	AttributeId	Index Range	W	Attribute Value	-
MethodCall	03	NodeId of the MethodCall / start Node	Relative path of the MethodCall node	-	-	C	-	-

NOTE 1 The table lists the most common three services and what data is provided in the HEADER, REQUEST & RESPONSE parameters of an EDD command.

NOTE 2 Based on the service, it can happen that the NodePath and/or AttributeId is not be applicable for all the service. In such case it is not mandatory to define the NODEPATH and/or ATTRIBUTE in EDD Header. For example, calling Write for writing value of a variable doesn't need to specify attribute value as 13 is assumed internally. In such case, the EDD header looks like this. "SERVICE_CODE=\"02\" NODEID=\"ns=2;s=TemperatureUnits\""

Key

R/W/C The Operation (in EDD) is READ (R) or WRITE (W) or COMMAND (C)

The supported EDD datatypes and equivalent OPC UA datatypes are described in Table 3.

Table 3 – EDD datatype mapping with OPC UA datatype

EDD Datatype	OPC UA Datatype
BOOLEAN	Boolean
DOUBLE	Double
FLOAT	Float
INTEGER(1,2,4,8)	SByte, Int16, Int32, Int64
UNSIGNED_INTEGER(1,2,4,8)	Byte, UInt16, UInt32, UInt64
DATE	DateTime (Ignore the Time Part)
DATE_AND_TIME	DateTime (Fill both) – Calender
DURATION	Duration
TIME	DateTime (Fill both) – Starting from 1984-01-01
TIME_VALUE	-
BIT_ENUMERATED	Enumeration(Int32)
ENUMERATED	Enumeration(Int32)
ASCII	String
BITSTRING	-
EUC	-
OCTET	ByteString
PACKED_ASCII	String
PASSWORD	String
VISIBLE	String

5.3 ProtocolIdentifier

The ProtocolIdentifier for OPC UA shall be “urn:fdipsd:OPCUA”.

5.4 Address

The Address is mapped to one of the *EndpointDescription* of the OPC UA Server running on the device. Refer to Clause 8 for the detailed information on the Scanning process.

The Address format:

“{serverUrl};{securitymode};{securitypolicy};{useridentitytoken};{identitydata}” in FDI® host.

Table 4 defines the Address attributes.

Table 4 – Address attributes

Attribute	Description
serverUrl	Unique URL of the OPC UA Device
securitymode	Selected security mode in which the OPC UA device shall establish the session, below are the possible values {0} – Invalid {1} – None {2} – Sign {3} – Sign&Encrypt
securityPolicies	Selected security policy in which the OPC UA device shall establish the session, the security policies are depends on server endpoints which identified during the scan result. Below are some examples: None, Basic256sha256 Aes128-Sha256-RsaOaep
useridentitytoken	Selected User Identity token to establish the session, below are the possible values Anonymous, UserName, Certificate
IdentityData	Based on the selection of useridentitytoken, the identity data shall be used. This is used to carry the metadata for User Identity. For ex, for UserName token the password shall be passed as a value for the Identity data. Encryption of identify data shall be done based on the Session encryption mechanism.
The certificate of the OPC UA device shall exchange with Communication Server (OPC UA client) automatically to establish the secure connection. NOTE 1 Identity data is only applicable for the Username Token policy. NOTE 2 Refer to IEC 62541-4 for more information about the security policies and User Token.	

5.5 Manufacturer

The mapping of Manufacturer depends on the capabilities of the OPC UA Server. If the Identified device is based on IEC 62541-100, the Manufacturer is mapped to the Manufacturer property of the DeviceType (see IEC 62541-100) For the other server types, the Manufacturer can be mapped from the ManufacturerName component of the ServerStatus->BuildInfo. For FDI® Gateways, the EDD data type EUC of length 256 shall be used and therefore the length of the string is limited to 256.