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Part 8: Data access

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OPC UNIFIED ARCHITECTURE –

Part 8: Data access

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International Standard IEC 62541-8 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) added new VariableTypes for AnalogItems;
- b) added an Annex that specifies a recommended mapping of OPC UA DataAccess to OPC COM DataAccess;
- c) changed the ambiguous description of "Bad_NotConnected";
- d) updated description for EUInformation to refer to latest revision of UNCEFACT units.

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

FDIS	Report on voting
65E/708/FDIS	65E/726/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

Throughout this document and the other parts of the IEC 62541 series, certain document conventions are used:

Italics are used to denote a defined term or definition that appears in the "Terms and definition" clause in one of the parts of the IEC 62541 series.

Italics are also used to denote the name of a service input or output parameter or the name of a structure or element of a structure that are usually defined in tables.

The *italicized terms and names* are, with a few exceptions, written in camel-case (the practice of writing compound words or phrases in which the elements are joined without spaces, with each element's initial letter capitalized within the compound). For example, the defined term is *AddressSpace* instead of Address Space. This makes it easier to understand that there is a single definition for *AddressSpace*, not separate definitions for Address and Space.

A list of all parts of the IEC 62541 series, published under the general title *OPC Unified Architecture*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
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OPC UNIFIED ARCHITECTURE –

Part 8: Data access

1 Scope

This part of IEC 62541 is part of the overall OPC Unified Architecture (OPC UA) standard series and defines the information model associated with Data Access (DA). It particularly includes additional *VariableTypes* and complementary descriptions of the *NodeClasses* and *Attributes* needed for Data Access, additional *Properties*, and other information and behaviour.

The complete address space model, including all *NodeClasses* and *Attributes* is specified in IEC 62541-3. The services to detect and access data are specified in IEC 62541-4.

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 TR 62541-1, *OPC Unified Architecture – Part 1: Overview and Concepts*

IEC 62541-3, *OPC Unified Architecture – Part 3: Address Space Model*

IEC 62541-4, *OPC Unified Architecture – Part 4: Services*

IEC 62541-5, *OPC Unified Architecture – Part 5: Information Model*

UN/CEFACT: UNECE Recommendation N° 20, *Codes for Units of Measure Used in International Trade*, available at https://www.unece.org/cefact/codesfortrade/codes_index.html

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TR 62541-1, IEC 62541-3, and IEC 62541-4 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

Dataltem

link to arbitrary, live automation data, that is, data that represents currently valid information

Note 1 to entry: Examples of such data are

- device data (such as temperature sensors),

- calculated data,
- status information (open/closed, moving),
- dynamically changing system data (such as stock quotes),
- diagnostic data.

3.1.2

AnalogItem

DatItem that represents continuously variable physical quantities (e.g. length, temperature), in contrast to the digital representation of data in discrete items

Note 1 to entry: Typical examples are the values provided by temperature sensors or pressure sensors. OPC UA defines a specific *VariableType* to identify an *AnalogItem*. *Properties* describe the possible ranges of *AnalogItems*.

3.1.3

DiscreteItem

DatItem that represents data that may take on only a certain number of possible values (e.g. OPENING, OPEN, CLOSING, CLOSED)

Note 1 to entry: Specific *VariableTypes* are used to identify *DiscreteItems* with two states or with multiple states. *Properties* specify the string values for these states.

3.1.4

ArrayItem

DatItem that represents continuously variable physical quantities and where each individual data point consists of multiple values represented by an array (e.g., the spectral response of a digital filter)

Note 1 to entry: Typical examples are the data provided by analyser devices. Specific *VariableTypes* are used to identify *ArrayItem* variants.

3.1.5

EngineeringUnits

units of measurement for *AnalogItems* that represent continuously variable physical quantities (e.g. length, mass, time, temperature) [EC 62541-8:2020](https://standards.itec.ai/)

Note 1 to entry: This standard defines *Properties* to inform about the unit used for the *DatItem* value and about the highest and lowest value likely to be obtained in normal operation.

3.2 Abbreviated terms and symbols

DA	data access
EU	engineering unit
UA	Unified Architecture

4 Concepts

Data Access deals with the representation and use of automation data in Servers.

Automation data can be located inside the *Server* or on I/O cards directly connected to the *Server*. It can also be located in sub-servers or on other devices such as controllers and input/output modules, connected by serial links via field buses or other communication links. OPC UA Data Access Servers provide one or more OPC UA Data Access *Clients* with transparent access to their automation data.

The links to automation data instances are called *DatItems*. The categories of automation data are provided is completely vendor-specific. Figure 1 illustrates how the *AddressSpace* of a *Server* might may consist of a broad range of different *DatItems*.

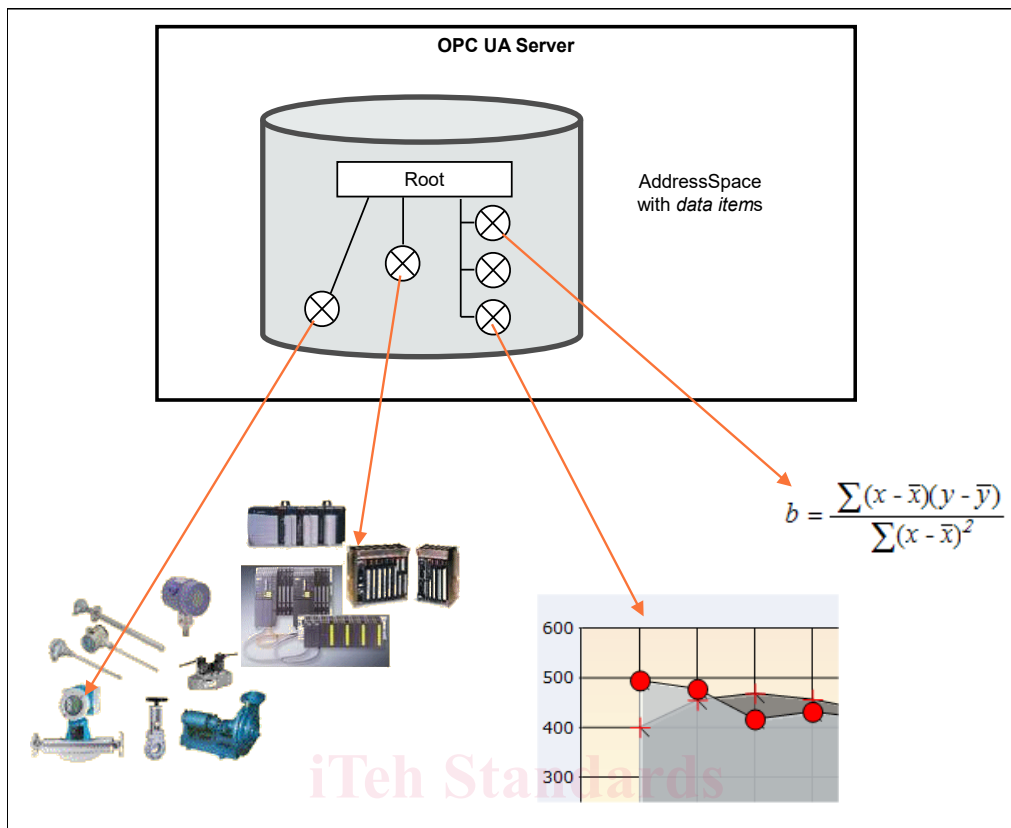


Figure 1 – OPC *Dataltems* are linked to automation data

IEC

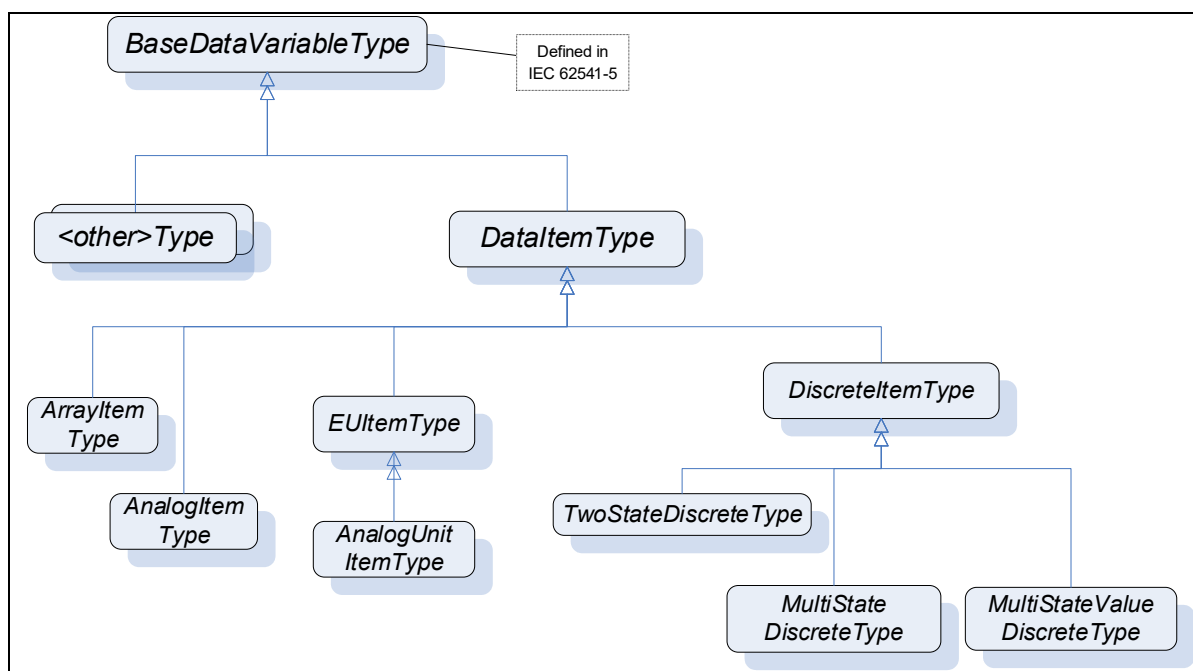
Clients may read or write *Dataltems*, or monitor them for value changes. The *Services* needed for these operations are specified in IEC 62541-4. Changes are defined as a change in status (quality) or a change in value that exceeds a client-defined range called a *Deadband*. To detect the value change, the difference between the current value and the last reported value is compared to the *Deadband*.

5 Model

5.1 General

The *DataAccess* model extends the variable model by defining *VariableTypes*. The *DataltemType* is the base type. *ArrayItem*, ~~*AnalogItem*~~ *BaseAnalogType* and *DiscreteItem* (and its *TwoState* and *MultiState* subtypes) are specializations. See Figure 2. Each of these *VariableTypes* can be further extended to form domain- or server-specific *Dataltems*.

Annex A specifies the recommended way for mapping the information received from OPC COM Data Access (DA) Servers to the model in this document.



IEC

Figure 2 – *Dataltem VariableType* hierarchy

5.2 SemanticsChanged

The *StatusCode* also contains an informational bit called *SemanticsChanged*.

Servers that implement Data Access shall set this Bit in notifications if certain *Properties* defined in this standard change. The corresponding *Properties* are specified individually for each *VariableType*.

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Clients that use any of these *Properties* should re-read them before they process the data value.

5.3 Variable Types

5.3.1 DataltemType

This *VariableType* defines the general characteristics of a *Dataltem*. All other *Dataltem* Types derive from it. The *DataltemType* derives from the *BaseDataVariableType* and therefore shares the variable model as described in IEC 62541-3 and IEC 62541-5. It is formally defined in Table 1.

Table 1 – DataItem Type definition

Attribute	Value				
BrowseName	DataItem Type				
IsAbstract	False				
ValueRank	-2 (-2 = 'Any')				
Data Type	BaseDataType				
References	NodeClass	BrowseName	Data Type	TypeDefinition	ModellingRule
Subtype of the <i>BaseDataVariableType</i> defined in IEC 62541-5; i.e the <i>Properties</i> of that type are inherited.					
HasSubtype	VariableType	AnalogItem Type	Defined in 5.3.2		
HasSubtype	VariableType	DiscreteItem Type	Defined in 5.3.3		
HasSubtype	VariableType	ArrayItem Type	Defined in 5.3.4		
HasProperty	Variable	Definition	String	PropertyType	Optional
HasProperty	Variable	ValuePrecision	Double	PropertyType	Optional

Definition is a vendor-specific, human-readable string that specifies how the value of this *DataItem* is calculated. *Definition* is non-localized and will often contain an equation that can be parsed by certain clients.

EXAMPLE: *Definition*::= "(TempA – 25) + TempB"

ValuePrecision specifies the maximum precision that the *Server* can maintain for the item based on restrictions in the target environment.

ValuePrecision can be used for the following *DataTypes*:

- for Float and Double values it specifies the number of digits after the decimal place;
- for DateTime values it indicates the minimum time difference in nanoseconds. For example, a *ValuePrecision* of 20 000 000 defines a precision of 20 ms.

The *ValuePrecision Property* is an approximation that is intended to provide guidance to a *Client*. A *Server* is expected to silently round any value with more precision that it supports. This implies that a *Client* may encounter cases where the value read back from a *Server* differs from the value that it wrote to the *Server*. This difference shall be no more than the difference suggested by this *Property*.

5.3.2 AnalogItem VariableTypes

~~This *VariableType* defines the general characteristics of an *AnalogItem*. All other *AnalogItem Types* derive from it. The *AnalogItem Type* derives from the *DataItem Type*. It is formally defined in Table 2.~~

5.3.2.1 General

The *VariableTypes* in this subclause define the characteristics of *AnalogItems*. The types have identical semantics and *Properties* but with diverging *ModellingRules* for individual *Properties*.

The *Properties* are only described once – in 5.3.2.2. The descriptions apply to the *Properties* for the other *VariableTypes* as well.

5.3.2.2 BaseAnalogType

This *VariableType* is the base type for analog items. All *Properties* are optional. Subtypes of this base type will mandate some of the *Properties*. The *BaseAnalogType* derives from the *DataItem Type*. It is formally defined in Table 2.