SLOVENSKI STANDARD
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Enotna arhitektura OPC - 13. del: Agregati (IEC 62541-13:2025)

OPC unified architecture - Part 13: Aggregates (IEC 62541-13:2025)

OPC Unified Architecture - Teil 13: Aggregation von Daten (IEC 62541-13:2025)

Architecture unifiée OPC - Partie 13: Agrégats (IEC 62541-13:2025)

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OPC unified architecture - Part 13: Aggregates (IEC 62541-13:2025)

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OPC Unified Architecture - Teil 13: Aggregation von Daten (IEC 62541-13:2025)

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

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European foreword

The text of document 65E/1059/CDV, future edition 3 of IEC 62541-13, 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 approved by CENELEC as EN IEC 62541-13:2026.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2027-02-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2029-02-28

This document supersedes EN IEC 62541-13:2020 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62541-13:2025 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 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 62541-1	-	OPC Unified Architecture - Part 1: Overview and concepts	EN IEC 62541-1	-
IEC 62541-3	-	OPC Unified Architecture - Part 3: Address Space Model	EN IEC 62541-3	-
IEC 62541-4	-	OPC unified architecture - Part 4: Services	EN IEC 62541-4	-
IEC 62541-5	-	OPC Unified architecture - Part 5: Information Model	EN IEC 62541-5	-
IEC 62541-8	-	OPC unified architecture - Part 8: Data access	EN IEC 62541-8	-
IEC 62541-11	-	OPC Unified Architecture - Part 11: Historical Access	EN IEC 62541-11	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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OPC unified architecture - Part 13: Aggregates

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62541-13 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

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

a) Multiple fixes for the computation of aggregates
   - The Raw status bit is always set for non-bad StatusCodes for the Start and End aggregates.
   - Entries in the Interpolative examples Tables A2.2 Historian1, Historian2, and Historian3 have been changed from Good to Good, Raw status codes when the timestamp matches with the timestamp of the data source.
   - Missing tables have been added for DurationInStateZero and DurationInStateNonZero.
   - The value of zero has been removed for results with a StatusCode of bad.
   - Data Type was listed as "Status Code" when it is "Double" for both Standard Deviation and both Variance Aggregates.
   - Rounding Error in TimeAverage and TimeAverage2 have been corrected.
   - The status codes have been corrected for the last two intervals and the value has been corrected in the last interval.
   - The wording has been changed to be more consistent with the certification testing tool.
   - UsedSlopedExtrapolation set to true for Historian2 and all examples locations needed new values or status' are modified.
   - Values affected by percent good and percent bad have been updated.
   - PercentGood/PercentBad are now accounted for in the calculation.
   - TimeAverage uses SlopedInterpolation but the Time aggregate is incorrectly allowed to used Stepped Interpolation.
   - Partial bit is now correctly calculated.
   - Unclear sentence was removed.
   - Examples have been moved to a CSV.
   - The value and status code for Historian 3 have been updated.
   - TimeAverage2 Historian1 now takes uncertain regions into account when calculating StatusCodes.
   - TimeAverage2 Historian2 now takes uncertain regions into account when calculating StatusCodes.
   - Total2 Historian1 now takes uncertain regions into account when calculating StatusCodes
   - Total2 Historian2 now takes uncertain regions into account when calculating StatusCodes
   - Maximum2 Historian1 now takes uncertain regions into account when calculating StatusCodes
   - MaximumActualTime2 Historian1 now takes uncertain regions into account when calculating StatusCodes
   - Minimum2 Historian1 now takes uncertain regions into account when calculating StatusCodes
   - MinimumActualTime2 Historian1 now has the StatusCodes calculated while using the TreatUncertainAsBad flag.
   - Range2 Historian1 now looks at TreatUncertainAsBad in the calculation of the StatusCodes.
   - Clarifications have been made to the text defining how PercentGood/PercentBad are used. The table values and StatusCodes of the TimeAverage2 and Total2 aggregates have been corrected.

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

Draft	Report on voting
65E/1059/CDV	65E/1098/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.

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 definitions" 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 in 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

1 Scope

This part of IEC 62541 is part of the overall OPC Unified Architecture specification series and defines the information model associated with Aggregates.

Programmatically produced aggregate examples are listed in Annex A.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments and errata) applies.

IEC 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*

IEC 62541-8, *OPC Unified Architecture - Part 8: Data Access*

IEC 62541-11, *OPC Unified Architecture - Part 11: Historical Access*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62541-1, IEC 62541-3, IEC 62541-4, and IEC 62541-11 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/

– ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
ProcessingInterval

timespan for which derived values are produced basedNo terms and definitions are listed in this document

Note 1 to entry: The total time domain specified for ReadProcessed is divided by the *ProcessingInterval*. For example, performing a 10-minute Average over the time range 12:00 to 12:30 would result in a set of three intervals of *ProcessingInterval* length, with each interval having a start time of 12:00, 12:10 and 12:20 respectively. The rules used to determine the interval *Bounds* are discussed in 5.4.2.2.

3.1.2
Interpolated data

data that is calculated from data samples

Note 1 to entry: Data samples can be historical data or buffered real time data. An *interpolated* value is calculated from the data points on either side of the requested timestamp.

3.1.3
EffectiveEndTime
time immediately before *endTime*

Note 1 to entry: All *Aggregate* calculations include the *startTime* but exclude the *endTime*. However, it is sometimes necessary to return an *Interpolated* End Bound as the value for an *Interval* with a timestamp that is in the *interval*. *Servers* are expected to use the time immediately before *endTime* where the time resolution of the *Server* determines the exact value (do not confuse this with hardware or operating system time resolution). For example, if the *endTime* is 12:01:00, the time resolution is 1 second, then the *EffectiveEndTime* is 12:00:59. See 5.4.2.4.

If time is flowing backwards, *Servers* are expected to use the time immediately after *endTime* where the time resolution of the *Server* determines the exact value.

3.1.4
Extrapolated data
data constructed from a discrete data set but is outside of the discrete data set

Note 1 to entry: It is similar to the process of interpolation, which constructs new points between known points, but its result is subject to greater uncertainty. *Extrapolated* data is used in cases where the requested time period falls farther into the future than the data available in the underlying system. See example in Table 1.

3.1.5
SlopedInterpolation
simple linear interpolation

Note 1 to entry: Compare to curve fitting using linear polynomials. See example in Table 1.

3.1.6
SteppedInterpolation
Interpolation holding the last data point constant or interpolating the value based on a horizontal line fit

Note 1 to entry: Consider the following Table 1 of raw and *Interpolated*/*Extrapolated* values:

Table 1 – Interpolation examples

Timestamp	Raw Value	Sloped Interpolation	Stepped Interpolation
12:00:00	10		
12:00:05		15	10
12:00:08		18	10
12:00:10	20		
12:00:15		25	20
12:00:20	30		
		SlopedExtrapolation	SteppedExtrapolation
12:00:25		35	30
12:00:27		37	30

3.1.7
bounding values
values at the *startTime* and *endTime* needed for *Aggregates* to compute the result

Note 1 to entry: If *Raw data* does not exist at the *startTime* and *endTime* a value shall be estimated. There are two ways to determine *Bounding Values* for an interval. One way (called *Interpolated Bounding Values*) uses the first non-Bad data points found before and after the timestamp to estimate the bound. The other (called *Simple Bounding Values*) uses the data points immediately before and after the boundary timestamps to estimate the bound even if these points are Bad. Entries 3.1.8 and 3.1.9 describe the two different approaches in more detail.

In all cases the *TreatUncertainAsBad* (see 4.2.1.2) flag is used to determine whether Uncertain values are Bad or non-Bad.

If a Raw value was not found and a non-Bad bounding value exists the *Aggregate* Bits (see 5.3.3) are set to 'Interpolated'.

When calculating *bounding values*, the value portion of *Raw data* that has Bad status is set to null. This means the value portion is not used in any calculation and a null is returned if the raw value is returned. The status portion is determined by the rules specified by the bound or *Aggregate*.

The *Interpolated Bounding Values* approach (see 3.1.8) is the same as what is used in Classic OPC Historical Data Access (HDA) and is important for applications such as advanced process control where having useful values at all times is important. The *Simple Bounding Values* approach (see 3.1.9) is new in this standard and is important for applications which shall produce regulatory reports and cannot use estimated values in place of Bad data.

3.1.8
interpolated bounding values
bounding values determined by a calculation using the nearest Good value

Note 1 to entry: *Interpolated Bounding Values* using *SlopedInterpolation* are calculated as follows:

- if a non-Bad Raw value exists at the timestamp then it is the bounding value;
- find the first non-Bad Raw value before the timestamp;
- find the first non-Bad Raw value after the timestamp;
- draw a line between before value and after value;
- use point where the line crosses the timestamp as an estimate of the bounding value.

The calculation can be expressed with the following formula:

$$V_{\text{bound}} = (T_{\text{bound}} - T_{\text{before}}) \times (V_{\text{after}} - V_{\text{before}}) / (T_{\text{after}} - T_{\text{before}}) + V_{\text{before}}$$

where V_x is a value at 'x' and T_x is the timestamp associated with V_x.

If no non-Bad values exist before the timestamp the *StatusCode* is Bad_NoData. The *StatusCode* is *Uncertain_DataSubNormal* if any Bad values exist between the before value and after value. If either the before value or the after value are Uncertain the *StatusCode* is *Uncertain_DataSubNormal*. If the after value does not exist the before value shall be extrapolated using *SlopedExtrapolation* or *SteppedExtrapolation*.

The period of time that is searched to discover the Good values before and after the timestamp is *Server* dependent, but if a Good value is not found within some reasonable time range then the *Server* will assume it does not exist. The *Server* as a minimum should search a time range which is at least the size of the ProcessingInterval.

Interpolated Bounding Values using *SlopedExtrapolation* are calculated as follows:

- find the first non-Bad Raw value before timestamp;
- find the second non-Bad Raw value before timestamp;
- draw a line between these two values;
- extend the line to where it crosses the timestamp;
- use the point where the line crosses the timestamp as an estimate of the bounding value.

The formula is the same as the one used for *SlopedInterpolation*.

The *StatusCode* is always *Uncertain_DataSubNormal*. If only one non-Bad raw value can be found before the timestamp then *SteppedExtrapolation* is used to estimate the bounding value.