

This is a preview - click here to buy the full publication



IEC TR 62541-1

Edition 3.0 2020-11
REDLINE VERSION

TECHNICAL REPORT



OPC unified architecture – Part 1: Overview and concepts

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40; 35.100.01

ISBN 978-2-8322-9093-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
1 Scope	7
2 Normative references	7
3 Terms, definitions, and abbreviated terms	8
3.1 Terms and definitions	8
3.2 Abbreviated terms	12
4 Structure of the OPC UA series	13
4.1 Specification organization	13
4.2 Core specification parts	14
4.3 Access Type specification parts	14
4.4 Utility specification parts	15
5 Overview	15
5.1 UA scope	15
5.2 General	15
5.3 Design goals	16
5.4 Integrated models and services	18
5.4.1 Security model	18
5.4.2 Integrated AddressSpace model	19
5.4.3 Integrated object model	20
5.4.4 Integrated services	20
5.5 Sessions	20
 5.6 Redundancy	21
6 Systems concepts	21
6.1 Client Server Overview	21
6.2 OPC UA Clients	21
6.3 OPC UA Servers	22
6.3.1 General	22
6.3.2 Real objects	23
6.3.3 Server application	23
6.3.4 OPC UA AddressSpace	23
6.3.5 Publisher/subscriber Subscription entities	24
6.3.6 OPC UA Service Interface	24
6.3.7 Server to Server interactions	25
6.4 Redundancy	26
6.5 Publish-Subscribe	26
6.6 Synergy of models	27
7 Service Sets	28
7.1 General	28
7.2 Discovery Service Set	28
7.3 SecureChannel Service Set	28
7.4 Session Service Set	29
7.5 NodeManagement Service Set	29
7.6 View Service Set	29
7.7 Query Service Set	29
7.8 Attribute Service Set	30
7.9 Method Service Set	30

7.10	MonitoredItem Service Set	30
7.11	Subscription Service Set	31
Bibliography		
<hr/>		
Figure 1	– OPC UA specification organization	13
Figure 2	– OPC UA target applications	17
Figure 3	– OPC UA System architecture	21
Figure 4	– OPC UA Client architecture	22
Figure 5	– OPC UA Server architecture	23
Figure 6	– Peer-to-peer interactions between Servers	25
Figure 7	– Chained Server example	26
Figure 8	– Integrated Client Server and PubSub models	27
Figure 9	– SecureChannel and Session Services	29

INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPC UNIFIED ARCHITECTURE –

Part 1: Overview and concepts

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 62541-1, which is a Technical Report, 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 of IEC TR 62541-1, published in 2016. This edition constitutes a technical revision.

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

- a) added Subclauses 6.5 and 6.6 and other text throughout to include PubSub introduction;
- b) added new transports and encodings to existing overview sections;
- c) removed WS-SecureConversation example since this mapping has been deprecated;
- d) improved the definition of Certificate.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
65E/678/DTR	65E/702/RVDTR

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

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

Throughout this document and the referenced other Parts of the 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 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 also often 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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

OPC UNIFIED ARCHITECTURE –

Part 1: Overview and concepts

1 Scope

This part of IEC 62541 presents the concepts and overview of the OPC Unified Architecture (OPC UA). Reading this document is helpful to understand the remaining parts of this multi-part document set. Each of the other parts of IEC 62541 is briefly explained along with a suggested reading order.

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 62541-2, *OPC unified architecture – Part 2: Security Model*

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 62541-6, *OPC unified architecture – Part 6: Mappings*

IEC 62541-7, *OPC unified architecture – Part 7: Profiles*

IEC 62541-8, *OPC unified architecture – Part 8: Data access*

IEC 62541-9, *OPC unified architecture – Part 9: Alarms and Conditions*

IEC 62541-10, *OPC unified architecture – Part 10: Programs*

IEC 62541-11, *OPC unified architecture – Part 11: Historical Access*

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

IEC 62541-13, *OPC Unified Architecture – Part 13: Aggregates*

IEC 62541-14, *OPC unified architecture – Part 14: PubSub*

ITU X.509, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks*
<https://www.itu.int/rec/T-REC-X.509>

TECHNICAL REPORT



OPC unified architecture – Part 1: Overview and concepts



CONTENTS

FOREWORD	4
1 Scope	6
2 Normative references	6
3 Terms, definitions, and abbreviated terms	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	11
4 Structure of the OPC UA series	12
4.1 Specification organization	12
4.2 Core specification parts	12
4.3 Access Type specification parts	13
4.4 Utility specification parts	13
5 Overview	14
5.1 UA scope	14
5.2 General.....	14
5.3 Design goals	14
5.4 Integrated models and services.....	16
5.4.1 Security model.....	16
5.4.2 Integrated AddressSpace model	17
5.4.3 Integrated object model	18
5.4.4 Integrated services	18
5.5 Sessions	18
6 Systems concepts	19
6.1 Client Server Overview	19
6.2 OPC UA Clients	19
6.3 OPC UA Servers	20
6.3.1 General	20
6.3.2 Real objects	20
6.3.3 Server application.....	20
6.3.4 OPC UA AddressSpace	21
6.3.5 Subscription entities	21
6.3.6 OPC UA Service Interface	21
6.3.7 Server to Server interactions	22
6.4 Redundancy.....	23
6.5 Publish-Subscribe	23
6.6 Synergy of models	24
7 Service Sets	25
7.1 General.....	25
7.2 Discovery Service Set.....	25
7.3 SecureChannel Service Set	25
7.4 Session Service Set.....	26
7.5 NodeManagement Service Set.....	26
7.6 View Service Set.....	26
7.7 Query Service Set.....	26
7.8 Attribute Service Set.....	27
7.9 Method Service Set.....	27
7.10 MonitoredItem Service Set.....	27

7.11	Subscription Service Set	28
Figure 1	– OPC UA specification organization	12
Figure 2	– OPC UA target applications	15
Figure 3	– OPC UA System architecture	19
Figure 4	– OPC UA Client architecture	19
Figure 5	– OPC UA Server architecture	20
Figure 6	– Peer-to-peer interactions between Servers	22
Figure 7	– Chained Server example	23
Figure 8	– Integrated Client Server and PubSub models	24
Figure 9	– SecureChannel and Session Services	26

INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPC UNIFIED ARCHITECTURE –

Part 1: Overview and concepts

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 62541-1, which is a Technical Report, 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 of IEC TR 62541-1, published in 2016. This edition constitutes a technical revision.

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

- a) added Subclauses 6.5 and 6.6 and other text throughout to include PubSub introduction;
- b) added new transports and encodings to existing overview sections;
- c) removed WS-SecureConversation example since this mapping has been deprecated;

d) improved the definition of Certificate.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
65E/678/DTR	65E/702/RVDTR

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

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

Throughout this document and the referenced other Parts of the 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 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 also often 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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

OPC UNIFIED ARCHITECTURE –

Part 1: Overview and concepts

1 Scope

This part of IEC 62541 presents the concepts and overview of the OPC Unified Architecture (OPC UA). Reading this document is helpful to understand the remaining parts of this multi-part document set. Each of the other parts of IEC 62541 is briefly explained along with a suggested reading order.

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 62541-2, *OPC unified architecture – Part 2: Security Model*

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 62541-6, *OPC unified architecture – Part 6: Mappings*

IEC 62541-7, *OPC unified architecture – Part 7: Profiles*

IEC 62541-8, *OPC unified architecture – Part 8: Data access*

IEC 62541-9, *OPC unified architecture – Part 9: Alarms and Conditions*

IEC 62541-10, *OPC unified architecture – Part 10: Programs*

IEC 62541-11, *OPC unified architecture – Part 11: Historical Access*

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

IEC 62541-13, *OPC Unified Architecture – Part 13: Aggregates*

IEC 62541-14, *OPC unified architecture – Part 14: PubSub*

ITU X.509, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks*
<https://www.itu.int/rec/T-REC-X.509>