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Part 16: State Machines

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



65E/1041/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 62541-16 ED1	
DATE OF CIRCULATION: 2024-01-26	CLOSING DATE FOR VOTING: 2024-04-19
SUPERSEDES DOCUMENTS: 65E/951/NP, 65E/1011/RVN	

IEC SC 65E : DEVICES AND INTEGRATION IN ENTERPRISE SYSTEMS	
SECRETARIAT: United States of America	SECRETARY: Mr Donald (Bob) Lattimer
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE: OPC Unified Architecture – Part 16: State Machines

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPC UNIFIED ARCHITECTURE –

Part 16: State Machines

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International Standard IEC 62541-16 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this international standard is based on the following documents:

CDV	Report on voting
65E/XX/CDV	65E/XX/RVC

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

Throughout this document and the other Parts of the series, certain document conventions are used:

145 *Italics* are used to denote a defined term or definition that appears in the “Terms and definition” clause
146 in one of the parts of the series.

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

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

154 A list of all parts of the IEC 62541 series is included in IEC 62541-1 clause 4 Structure of the OPC UA
155 series and published under the general title OPC Unified Architecture, can be found on the IEC website.

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

- 159 • reconfirmed,
- 160 • withdrawn,
- 161 • replaced by a revised edition, or
- 162 • amended.

163

164 A bilingual version of this publication may be issued at a later date.

165

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OPC Unified Architecture Specification

Part 16: State Machines

1 Scope

This part of the OPC Unified Architecture defines an Information Model. The Information Model describes the basic infrastructure to model state machines.

Note: In the previous version, File Transfer was in IEC 62541-5, Annex B

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

IEC 62541-7, *OPC Unified Architecture – Part 7: Profiles*

IEC 62541-9, *OPC Unified Architecture – Part 9: Alarms and Conditions*

IEC 62541-10, *OPC Unified Architecture – Part 10: Programs*

3 Terms, definitions, abbreviated terms, and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62541-1, IEC 62541-3, and IEC 62541-5 apply.

4 State Machine Model

4.1 General

This document describes the basic infrastructure to model state machines. It defines *ObjectTypes*, *VariableTypes* and *ReferenceTypes* and explains how they should be used.

This document is an integral part of this standard, that is, the types defined in this document shall be used as defined. However, it is not required but strongly recommended that a *Server* uses these types to expose its state machines. The defined types may be subtyped to refine their behaviour.

When a *Server* exposes its state machine using the types defined in this document, it might only provide a simplified view on its internal state machine, hiding for example substates or putting several internal states into one exposed state.

The scope of the state machines described in this document is to provide an appropriate foundation for state machines needed for IEC 62541-9 and IEC 62541-10. It does not provide more complex functionality of a state machine like parallel states, forks and joins, history states, choices, and junctions, etc. However, the base state machine defined in this document can be extended to support such concepts.

The following clauses describe examples of state machines, define state machines in the context of this document and define the representation of state machines in OPC UA. Finally, some examples of state machines, represented in OPC UA, are given.

4.2 Examples of finite state machines

4.2.1 Simple state machine

The following example provides an overview of the base features that the state machines defined in this specification will support. In the following, a more complex example is given, that also supports sub-state machines.

Figure 1 gives an overview over a simple state machine. It contains the three states "State1", "State2" and "State3". There are transitions from "State1" to "State2", "State2" to "State2", etc. Some of the transitions provide additional information with regard to what causes (or triggers) the transition, for example the call of "Method1" for the transition from "State1" to "State2". The effect (or action) of the transition can also be specified, for example the generation of an *Event* of the "EventType1" in the same transition. The notation used to identify the cause is simply listing it on the transition, the effect is prefixed with a "/". More than one cause or effect are separated by a ",". Not every transition has to have a cause or effect, for example the transition between "State2" and "State3".

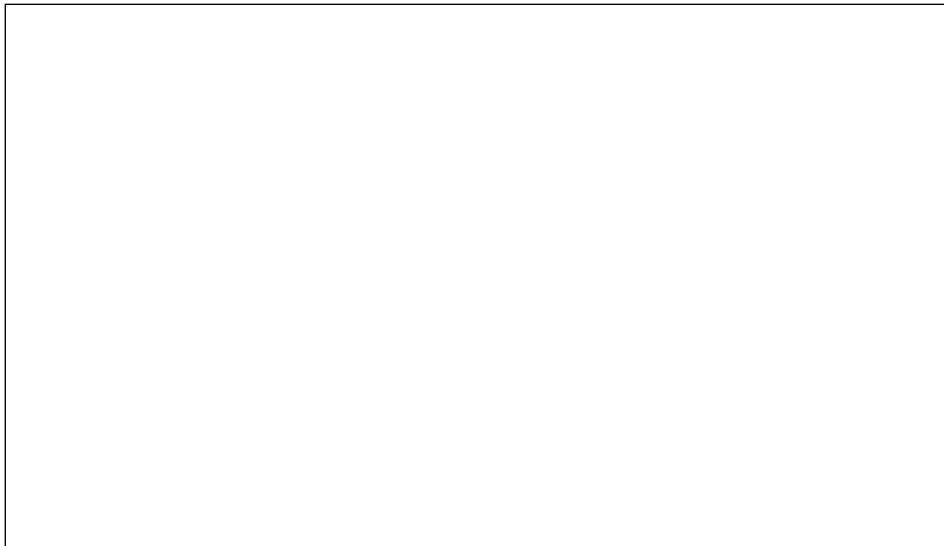


Figure 1 – Example of a simple state machine

For simplicity, the state machines described in this specification will only support causes in form of specifying *Methods* that have to be called and effects in form of *EventTypes* or *Events* that are generated. However, the defined infrastructure allows extending this to support additional different causes and effects.

4.2.2 State machine containing substates

Figure 2 shows an example of a state machine where "State6" is a sub-state-machine. This means, that when the overall state machine is in State6, this state can be distinguished to be in the sub-states "State7" or "State8". Sub-state-machines can be nested, that is, "State7" could be another sub-state-machine.