

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Engineering data exchange format for use in industrial automation systems
engineering – Automation markup language –
Part 5: Communication**

**Format d'échange de données techniques pour une utilisation dans l'ingénierie
des systèmes d'automatisation industrielle – Automation markup language –
Partie 5: Communication**





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.



IEC 62714-5

Edition 1.0 2022-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Engineering data exchange format for use in industrial automation systems
engineering – Automation markup language –
Part 5: Communication**

**Format d'échange de données techniques pour une utilisation dans l'ingénierie
des systèmes d'automatisation industrielle – Automation markup language –
Partie 5: Communication**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.040; 25.040.01

ISBN 978-2-8322-1085-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD	6
1 Scope	8
2 Normative references	8
3 Terms, definitions, abbreviated terms and acronyms	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms and acronyms	9
4 Use cases and network structures	10
4.1 General.....	10
4.2 Use cases	10
4.2.1 Engineering activities.....	10
4.2.2 Lossless transfer of communication device instance information.....	11
4.2.3 Lossless transfer of communication system information.....	14
4.3 Delimitation of modelling range	16
4.3.1 Scope of the modelling range	16
4.3.2 Interaction structures and life cycles	16
4.3.3 Network objects	17
4.3.4 Network topologies	18
4.3.5 Communication content	23
4.4 Derived modelling requirements	23
5 UML model	24
5.1 Overview	24
5.2 Logical topology	24
5.2.1 Aim of logical topology	24
5.2.2 Item logicalTopology	25
5.2.3 Item logicalConnection	25
5.2.4 Item logicalEndPoint	25
5.3 Physical topology	26
5.3.1 Aim of physical topology	26
5.3.2 Item physicalTopology	26
5.3.3 Item physicalConnection	26
5.3.4 Item physicalEndPoint	27
5.4 Device	27
5.4.1 General	27
5.4.2 Item physicalDevice	27
5.4.3 Item Information	28
5.4.4 Item physicalDeviceInformation	29
5.4.5 Item logicalDeviceInformation	29
5.4.6 Item logicalDevice	29
5.4.7 Item networkDataList	29
5.4.8 Item networkDataItem	29
5.4.9 Item logicalEndPointList	29
5.4.10 Item physicalEndPointList	29
5.4.11 Item physicalChannelList	29
5.4.12 Item physicalChannel	30
5.4.13 Item deviceResource	30
5.4.14 Item variableList	30
5.4.15 Item variable	30

5.4.16	Item pduList.....	31
5.4.17	Item pdu	31
5.4.18	Item protocolData	32
5.4.19	Item payload.....	32
5.4.20	Item processDataItemList	32
5.4.21	Item parameterItemList	32
5.4.22	Item dataItem	32
5.4.23	Item processDataItem	32
5.4.24	Item processDataInput.....	33
5.4.25	Item processDataOutput	33
5.4.26	Item parameterItem	33
6	Representation within AutomationML.....	33
6.1	Overview of mapping	33
6.1.1	Introduction of mapping	33
6.1.2	General mapping rules.....	33
6.1.3	Basics	34
6.1.4	Modelling of relations.....	35
6.1.5	Application process	36
6.2	Basic communication role class library.....	38
6.2.1	General	38
6.2.2	RoleClass PhysicalDevice	39
6.2.3	RoleClass PhysicalEndpointlist.....	40
6.2.4	RoleClass PhysicalConnection	40
6.2.5	RoleClass PhysicalNetwork	40
6.2.6	RoleClass LogicalDevice	41
6.2.7	RoleClass LogicalEndpointlist.....	41
6.2.8	RoleClass LogicalConnection	41
6.2.9	RoleClass LogicalNetwork	41
6.3	Basic communication interface class library	42
6.3.1	General	42
6.3.2	InterfaceClass PhysicalEndPoint	42
6.3.3	InterfaceClass LogicalEndPoint	42
6.4	Steps to model technology specific libraries	43
6.4.1	General	43
6.4.2	Step 1: Development of technology specific role classes	43
6.4.3	Step 2: Development of technology specific interface classes	44
6.4.4	Step 3: Development of system unit class libraries	44
6.4.5	Step 4: Modelling the network	45
6.4.6	Step 5: Modelling the connections	46
6.5	PDU modelling	46
6.5.1	General	46
6.5.2	RoleClass CommunicationPackage.....	47
6.5.3	InterfaceClass DatagrammObject	48
6.5.4	Steps to model technology specific libraries.....	49
6.6	References to attributes	51
6.7	Usage of metadata.....	53
	Bibliography.....	55

Figure 1 – General engineering activities communication system engineering is embedded within.....	10
Figure 2 – Information flow of the use case.....	12
Figure 3 – Alternative information flow of the use case	13
Figure 4 – Information flow of the use case.....	15
Figure 5 – Example of a logical level view on communication systems.....	17
Figure 6 – Example of a physical level view on communication systems	18
Figure 7 – Combined views on communication systems	18
Figure 8 – Star topology example.....	19
Figure 9 – Ring topology example.....	19
Figure 10 – Line topology example	20
Figure 11 – Simple network with direct wiring	20
Figure 12 – Network with active infrastructure.....	21
Figure 13 – Networks connected by gateways.....	21
Figure 14 – Hierarchical structured networks	22
Figure 15 – Network covering multiple applications.....	22
Figure 16 – General modelling strategy for PDUs.....	23
Figure 17 – Structure of communication network.....	24
Figure 18 – View on logical topology.....	25
Figure 19 – View on physical topology	26
Figure 20 – Part 1 of the device model.....	28
Figure 21 – Part 2 of the device model.....	31
Figure 22 – Communication role class library and communication interface class library	35
Figure 23 – Derived role class libraries and interface class libraries for a special example	35
Figure 24 – SystemUnitClassLib examples for communication system modelling	37
Figure 25 – Final network model example	38
Figure 26 – Basic communication role class library	39
Figure 27 – CommunicationRoleClassLib	39
Figure 28 – XML text of the communication role class library	39
Figure 29 – Basic communication interface class library	42
Figure 30 – CommunicationInterfaceClassLib	42
Figure 31 – XML text of the communication interface class library	42
Figure 32 – Derivation of a technology specific role class library out of the base role class library	43
Figure 33 – Derivation of a technology specific role class library out of the base role class library	44
Figure 34 – Technology specific <SystemUnitClassLib>s	45
Figure 35 – Technology specific communication network	46
Figure 36 – Extended communication role class library	47
Figure 37 – Extended CommunicationRoleClassLib	47
Figure 38 – XML text of the extended communication role class library	47
Figure 39 – Extended communication interface class library	48
Figure 40 – Extended CommunicationInterfaceClassLib	48

Figure 41 – XML text of the extended communication role class library.....	48
Figure 42 – Derivation of a technology specific role class library out of the extended role class library	49
Figure 43 – Derivation of a technology specific interface class library out of the extended interface class library.....	50
Figure 44 – Technology specific extended <SystemUnitClassLib>s.....	50
Figure 45 – Technology specific communication network with communication package models.....	51
Figure 46 – Field SourceDocumentInformation according to communication related libraries	54
Table 1 – Mapping rules	34
Table 2 – Modelling of relations in AutomationML	36
Table 3 – RoleClass PhysicalDevice	40
Table 4 – RoleClass PhysicalEndpointlist	40
Table 5 – RoleClass PhysicalConnection	40
Table 6 – RoleClass PhysicalNetwork	40
Table 7 – RoleClass LogicalDevice	41
Table 8 – RoleClass LogicalEndpointlist	41
Table 9 – RoleClass LogicalConnection	41
Table 10 – RoleClass LogicalNetwork	41
Table 11 – InterfaceClass PhysicalEndPoint	42
Table 12 – InterfaceClass LogicalEndPoint	43
Table 13 – RoleClass CommunicationPackage	48
Table 14 – InterfaceClass DatagrammObject	49
Table 15 – Communication related attributes	52

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENGINEERING DATA EXCHANGE FORMAT FOR USE
IN INDUSTRIAL AUTOMATION SYSTEMS ENGINEERING –
AUTOMATION MARKUP LANGUAGE –****Part 5: Communication****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.

IEC 62714-5 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.

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

Draft	Report on voting
65E/844/FDIS	65E/886/RVD

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/standardsdev/publications.

A list of all parts of the IEC 62714 series, under the general title *Engineering data exchange format for use in industrial automation systems engineering – Automation markup language*, 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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

ENGINEERING DATA EXCHANGE FORMAT FOR USE IN INDUSTRIAL AUTOMATION SYSTEMS ENGINEERING – AUTOMATION MARKUP LANGUAGE –

Part 5: Communication

1 Scope

Engineering processes of technical systems and their embedded automation systems are executed with increasing efficiency and quality. Especially since the project duration tends to increase as the complexity of the engineered system increases. To solve this problem, the engineering process is more often being executed by exploiting software based engineering tools exchanging engineering information and artefacts along the engineering process related tool chain.

Communication systems establish an important part of modern technical systems and, especially, of automation systems embedded within them. Following the increasing decentralisation of automation systems and the application of fieldbus and Ethernet technology connecting automation devices and further interacting entities need to fulfil special requirements on communication quality, safety and security. Thus, within the engineering process of modern technical systems, engineering information and artefacts relating to communication systems also need to be exchanged along the engineering process tool chain.

In each phase of the engineering process of technical systems, communication system related information can be created which can be consumed in later engineering phases. A typical application case is the creation of configuration information for communication components of automation devices including communication addresses and communication package structuring within controller programming devices during the control programming phase and its use in a device configuration tool. Another typical application case is the transmission of communication device configurations to virtual commissioning tools, to documentation tools, or to diagnosis tools.

At present, the consistent and lossless transfer of communication system engineering information along the complete engineering chain of technical systems is unsolved. While user organisations and companies have provided data exchange formats for parts of the relevant information like FDCML, EDDL, and GSD, the above named application cases cannot be covered by a data exchange format. Notably the networking related information describing communication relations and their properties and qualities cannot be modelled by a data exchange format.

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 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC 61131-10:2019, *Programmable controllers – Part 10: PLC open XML exchange format*

IEC 62424:2016, *Representation of process control engineering – Requests in P&I diagrams and data exchange between P&ID tools and PCE-CAE tools*

IEC 62714-1, *Engineering data exchange format for use in industrial systems engineering – Automation Markup Language – Part 1: Architecture and general requirements*

IEC 62714-4, *Engineering data exchange format for use in industrial systems engineering – Automation markup language – Part 4: Logic*

IEC 81346 (all parts), *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations*

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62714-1 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

AutomationML/AML

XML based data exchange format for plant engineering data

3.1.2

Automation object

entity in an automated system

Note 1 to entry: An example of an automation object is an automation component, a valve, or a signal.

3.2 Abbreviated terms and acronyms

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

AML	Automation Markup Language
CAEX	Computer Aided Engineering Exchange as defined in IEC 62424:2016
ECAD	Computer aided engineering for electrical engineering
EDDL	Electronic Device Description Language
FDCML	Field Device Configuration Markup Language
GUID	Global Unique Identifier
GSD	General Station Description
HMI	Human Machine Interface
ID	Identifier
MCAD	Computer aided engineering for mechanical engineering
OPC	Open Platform Communications
PDU	Protocol Data Unit
SCADA	Supervisory Control And Data Acquisition
UML	Unified Modelling Language
UUID	Universal Unique Identifier
XML	Extensible Markup Language