

© Copyright SEK Svensk Elstandard. Reproduction in any form without permission is prohibited.

## Gränssnitt för EMS (EMS-API) – Del 401: Ramverk för profilering

*Energy management system application program interface (EMS-API) –  
Part 401: Profile framework*

Som svensk standard gäller europastandarden EN IEC 61970-401:2022. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61970-401:2022.

### Nationellt förord

Europastandarden EN IEC 61970-401:2022

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61970-401, First edition, 2022 - Energy management system application program interface (EMS-API) - Part 401: Profile framework**

utarbetad inom International Electrotechnical Commission, IEC.

---

ICS 33.200.00

---

Denna standard är fastställd av SEK Svensk Elstandard, som också kan lämna upplysningar om **sakinnehållet** i standarden.  
Postadress: Box 1284, 164 29 KISTA  
Telefon: 08 - 444 14 00.  
E-post: sek@elstandard.se. Internet: www.elstandard.se

---

### *Standarder underlättar utvecklingen och höjer elsäkerheten*

Det finns många fördelar med att ha gemensamma tekniska regler för bl a mätning, säkerhet och provning och för utförande, skötsel och dokumentation av elprodukter och elanläggningar.

Genom att utforma sådana standarder blir säkerhetsfordringar tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

### *SEK är Sveriges röst i standardiseringsarbetet inom elområdet*

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

### *Stora delar av arbetet sker internationellt*

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

### *Var med och påverka!*

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

### **SEK Svensk Elstandard**

Box 1284  
164 29 Kista  
Tel 08-444 14 00  
[www.elstandard.se](http://www.elstandard.se)

ICS 33.200

English Version

**Energy management system application program interface  
(EMS-API) - Part 401: Profile framework  
(IEC 61970-401:2022)**

Interface de programmation d'application pour système de gestion d'énergie (EMS-API) - Partie 401: Cadre de profils (IEC 61970-401:2022)

Schnittstelle für Anwendungsprogramme für Netzführungssysteme (EMS-API) - Teil 401: Rahmenwerk für Profile (IEC 61970-401:2022)

This European Standard was approved by CENELEC on 2022-07-04. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## **European foreword**

The text of document 57/2482/FDIS, future edition 1 of IEC 61970-401, prepared by IEC/TC 57 "Power systems management and associated information exchange" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61970-401:2022.

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) 2023-04-04
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2025-07-04

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.

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 61970-401:2022 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.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61968-11	-	Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution	EN 61968-11	-
IEC/TS 61970-2	-	Energy management system application program interface (EMS-API) - Part 2: Glossary	CLC/TS 61970-2	-
IEC 61970-300	series	Energy management system application program interface (EMS-API)	-	-
IEC 61970-501	2006	Energy management system application program interface (EMS-API) - Part 501: Common Information Model Resource Description Framework (CIM RDF) schema	EN 61970-501	2006
IEC 61970-552	-	Energy management system application program interface (EMS-API) - Part 552: CIMXML Model exchange format	EN 61970-552	-
OMG Unified-Modeling Language®		OMG document number: formal/2015-03-01, available at <a href="http://www.omg.org/spec/UML/2.5">http://www.omg.org/spec/UML/2.5</a>		-
World Wide Web-Consortium (W3C)		RDF 1.1 Primer from 24 June 2014, available at <a href="https://www.w3.org/TR/rdf11-primer/">https://www.w3.org/TR/rdf11-primer/</a>	-	-
World Wide Web-Consortium (W3C)		RDF 1.1 Concepts and Abstract Syntax from 25 February 2014, available at <a href="https://www.w3.org/TR/rdf11-concepts/">https://www.w3.org/TR/rdf11-concepts/</a>	-	-
World Wide Web-Consortium (W3C)		RDF 1.1 XML Syntax from 25 February 2014, available at <a href="https://www.w3.org/TR/rdf-syntax-grammar/">https://www.w3.org/TR/rdf-syntax-grammar/</a>	-	-
World Wide Web-Consortium (W3C)		RDF Schema 1.1 from 25 February 2014, available at <a href="https://www.w3.org/TR/rdf-schema/">https://www.w3.org/TR/rdf-schema/</a>	-	-

## EN IEC 61970-401:2022 (E)

World Wide Web- Consortium (W3C)	OWL 2 Web Ontology Language Primer - (Second Edition), W3C Recommendation 11 December 2012, available at <a href="https://www.w3.org/TR/owl2-primer/">https://www.w3.org/TR/owl2-primer/</a>	-
World Wide Web- Consortium (W3C)	OWL 2 Web Ontology Language Structural - Specification and Functional-Style Syntax (Second Edition), W3C Recommendation 11 December 2012, available at <a href="https://www.w3.org/TR/owl2-syntax/">https://www.w3.org/TR/owl2-syntax/</a>	-

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**Energy management system application program interface (EMS-API) –  
Part 401: Profile framework**

**Interface de programmation d'application pour système de gestion d'énergie  
(EMS-API) –  
Partie 401: Cadre de profils**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 33.200

ISBN 978-2-8322-0093-3

**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.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms, definitions and abbreviated terms .....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	10
4 Overview .....	11
4.1 Profiles and profiling .....	11
4.2 Relations between Canonical CIM, profiles and datasets .....	13
4.3 Profiles and business processes .....	14
5 Profile document structure.....	15
6 Profiling Use cases.....	15
6.1 Overview.....	15
6.2 Class in different profiles with no overlap.....	16
6.3 Include overlapping sets of attributes and roles from the same class in different profiles.....	17
6.4 Include a base class with different sets of attributes or roles.....	17
6.5 Extending an existing class.....	17
6.6 Extending an existing class used differently in different profiles .....	18
6.7 Different cardinalities .....	18
6.8 Add a new datatype .....	19
7 Profiling rules .....	19
7.1 Overview.....	19
7.2 R0101 Information model class, attribute, role and datatype names .....	19
7.3 Class rules for classes without stereotype.....	19
7.3.1 R0201 Including a class.....	19
7.3.2 R0202 Adding a new class.....	19
7.3.3 R0203 The description of a class .....	19
7.3.4 R0204 Name of a class.....	19
7.3.5 R0205 Cardinality of a class .....	19
7.3.6 R0206 Concrete class.....	20
7.4 Attribute rules .....	20
7.4.1 R0301 Including an attribute .....	20
7.4.2 R0302 Adding a new attribute.....	20
7.4.3 R0303 The description of an attribute .....	20
7.4.4 R0304 The name of an attribute.....	20
7.4.5 R0305 The cardinality of an attribute .....	20
7.4.6 R0306 The datatype of an attribute.....	20
7.4.7 R0307 Initial value of an attribute .....	20
7.5 Datatypes .....	21
7.5.1 R0401 Including a datatype .....	21
7.5.2 R0402 Adding a new datatype .....	21
7.5.3 R0403 Primitive datatype.....	21
7.5.4 R0405 CIMDatatype .....	21
7.5.5 R0405 Compound datatype .....	21

7.5.6	R0406 Enumeration .....	21
7.5.7	R0407 The description of a datatype .....	21
7.5.8	R0408 The name of a datatype .....	21
7.6	Association rules .....	22
7.6.1	R0501 Including an association .....	22
7.6.2	R0502 Adding a new association .....	22
7.6.3	R0503 The names of the two roles in an association .....	22
7.6.4	R0504 The cardinality of an association role .....	22
7.6.5	R0505 Association navigability .....	22
7.6.6	R0506 The description of an association .....	22
7.7	Attribute and association restrictions .....	22
7.7.1	R0601 Overlap between profiles .....	22
7.7.2	R0602 Same base class with different sets of attributes and associations in different profiles .....	23
7.8	R0701 Inheritance structure .....	23
7.9	R0801 Constraints .....	23
8	Extending Canonical CIM .....	24
9	Requirements for a profiling tool .....	24
9.1	Minimum requirements .....	24
9.2	Extended requirements for OCL rules .....	25
Annex A (informative)	.....	26
A.1	Mapping of UML to OWL .....	26
A.2	Units and multipliers issue .....	26
A.2.1	Description of issue .....	26
A.2.2	Long term solution .....	30
A.2.3	Medium term solution .....	30
A.2.4	Temporary solution by flattening the profiles .....	31
A.2.5	Temporary solution by fattening the CIMXML data .....	31
A.2.6	Maintaining information for a flattened profile .....	32
Figure 1	– Relations between standards and profiling .....	12
Figure 2	– Relation between Canonical CIM, profiles and datasets .....	13
Figure 3	– Class in different profiles with no overlap .....	16
Figure 4	– Class in different profiles with overlap .....	17
Figure 5	– Same base class with different sets of attributes or roles .....	17
Figure 6	– Extending a class the same way in all applicable profiles .....	18
Figure 7	– Extending an existing class used differently in different profiles .....	18
Figure A.1	– CIMDatatype example in Canonical CIM and SSH profile .....	27
Figure A.2	– ActivePower from IEC 61970-452:2021 (CIM16) .....	28
Figure A.3	– Profile for ActivePower including CIMDatatype attributes .....	28
Figure A.4	– CIMXML example with an ActivePower instance as an identified node .....	29
Figure A.5	– CIMXML example with an ActivePower blank node serialisation example .....	29
Figure A.6	– Profile for ActivePower based on CIM version 9 (CIM9) .....	29

Figure A.7 – CIMXML example with an ActivePower instance according to the original serialisation ..... 29

Figure A.8 – Example of Flattened profile for ActivePower ..... 31

  

Table 1 – Abbreviated terms ..... 11

Table A.1 – UML and ontology languages ..... 26

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENERGY MANAGEMENT SYSTEM APPLICATION  
PROGRAM INTERFACE (EMS-API) –****Part 401: Profile framework**

## 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 61970-401 has been prepared by IEC technical committee 57: Power systems management and associated information exchange. It is an International Standard.

This first edition cancels and replaces IEC TS IEC 61970-401 published in 2005. This edition constitutes a technical revision.

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

- a) The previous edition of IEC TS 61970-401:2005 provided an overview of the Component Interface Specifications (CIS) IEC 61970-402, IEC 61970-403, IEC 61970-404, IEC 61970-405, and IEC 61970-407. IEC 61970-402 to IEC 61970-407 are duplicates of existing OPC interfaces from OPC Foundation and the DAIS/HDA interfaces from OMG. Hence IEC 61970-402 to IEC 61970-407 have been withdrawn and IEC TS 61970-401:2005 no longer serves a purpose.

- b) IEC 61970-401 (this document) does not contain an overview of Component Interface Specifications (CIS) but instead a description of how to create profile specifications that describes dataset contents (or message contents). Hence it has been renamed "Profile framework". The profile specifications IEC 61970-450 (all parts) and IEC 61970-600 (all parts) describe dataset contents. The purpose of this document is to define the rules to be followed in the process of creating profile specifications.

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

Draft	Report on voting
57/2482/FDIS	57/2494/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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

A list of all parts in the IEC 61970 series, published under the general title *Energy management system application program interface (EMS-API)*, 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,
- 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.**

## INTRODUCTION

This document is one of the IEC 61970 series that defines message interfaces for network application data exchange.

The IEC 61970-300 series of documents specify a canonical Common Information Model (CIM) describing network application data. The CIM is an information model that represents all the major objects in an electric utility enterprise needed to describe data used by power network applications. The Canonical CIM provides the semantics for IEC 61970-450 (all parts) and IEC 61970-600 (all parts) profile specifications dedicated to specific data exchanges.

This document describes the framework in which profile specifications are created from the Canonical CIM. It describes the structure of profile documents and the rules for selection of information from the Canonical CIM to be included in profile specifications.

The reasons for creating this document are

- 1) The IEC 61970 profiles have for a long time been created using a profiling method not described by an IEC 61970 document.
- 2) The IEC 61970 profiling method has issues that need resolution. Issues and solutions are described in Annex A.

# ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

## Part 401: Profile framework

### 1 Scope

This document describes how IEC 61970-450 (all parts), IEC 61970-600 (all parts) profile specifications are structured and created. Profile specifications describe a subset of the Canonical CIM dedicated to a specific data exchange. The Canonical CIM is described in IEC 61970-300 (all parts) as well as in IEC 61968-11.

Rules for creation or extension of Canonical CIM are outside the scope of this document.

This document specifies the structure of a profile specification and the rules for selecting subsets of information from the Canonical CIM. It standardizes the operations used to create the profile elements from the Canonical CIM. As Canonical CIM is described in UML the operations are described in terms of UML classes, attributes, and roles.

It is possible to map UML to RDFS or OWL, so any of the languages UML, RDFS or OWL can be used to describe the created profiles. Specification of languages (UML, RDFS or OWL) used to describe profiles as well as how profiles are presented and edited in user interfaces are outside the scope of this document. Languages used to describe profiles are specified in other specifications. Relevant specifications are referenced in Clause 2.

UML supports adding free text that describes further restrictions on UML constructs, e.g. classes, attribute values, association roles and cardinalities. Languages such as OCL and SHACL are dedicated to describing constraints. OCL is used to describe constraints for object data described in UML while SHACL is used to describe constraints on graph data described by RDFS or OWL. OCL is within the scope of this document, but SHACL is not.

This document supports profiles describing data exchanged as CIMXML datasets or messages. The exchange format within the scope is in accordance with IEC 61970-552 but other formats are possible.

Tool interoperability and serialisation formats are outside the scope of this document.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the 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 61968-11, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

IEC 61970-300 (all parts), *Energy management system application program interface (EMS-API)*

IEC 61970-501:2006, *Energy management system application program interface (EMS-API) – Part 501: Common Information Model Resource Description Framework (CIM RDF) schema*<sup>1</sup>

IEC 61970-552, *Energy management system application program interface (EMS-API) – Part 552: CIMXML Model exchange format*

OMG Unified Modeling Language®, OMG document number: formal/2015-03-01, available at <http://www.omg.org/spec/UML/2.5>

World Wide Web Consortium (W3C), RDF 1.1 Primer from 24 June 2014, available at <https://www.w3.org/TR/rdf11-primer/>

World Wide Web Consortium (W3C), RDF 1.1 Concepts and Abstract Syntax from 25 February 2014, available at <https://www.w3.org/TR/rdf11-concepts/>

World Wide Web Consortium (W3C), RDF 1.1 XML Syntax from 25 February 2014, available at <https://www.w3.org/TR/rdf-syntax-grammar/>

World Wide Web Consortium (W3C), RDF Schema 1.1 from 25 February 2014, available at <https://www.w3.org/TR/rdf-schema/>

World Wide Web Consortium (W3C), OWL 2 Web Ontology Language Primer (Second Edition), W3C Recommendation 11 December 2012, available at <https://www.w3.org/TR/owl2-primer/>

World Wide Web Consortium (W3C), OWL 2 Web Ontology Language Structural Specification and Functional-Style Syntax (Second Edition), W3C Recommendation 11 December 2012, available at <https://www.w3.org/TR/owl2-syntax/>

---

<sup>1</sup> This specification is based on the W3C specification RDF Schema 1.0 from early 2000 which has since been revised multiple times.