

TECHNICAL SPECIFICATION



**Energy management system application program interface (EMS-API) –
Part 555: CIM based efficient model exchange format (CIM/E)**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 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.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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: csc@iec.ch.

TECHNICAL SPECIFICATION



**Energy management system application program interface (EMS-API) –
Part 555: CIM based efficient model exchange format (CIM/E)**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.200

ISBN 978-2-8322-3653-6

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

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
4 Use case.....	8
4.1 General.....	8
4.2 Real-time sharing on CIM model.....	8
4.3 Online Dynamic Stability Analysis (DSA).....	10
5 Symbol definitions	10
6 Structure Specification.....	11
6.1 General.....	11
6.2 Basic structure	11
6.3 Comment	12
6.4 System declaration.....	12
6.5 Root element	13
6.6 Model header.....	13
6.7 Block structure.....	13
6.8 Data block.....	14
6.8.1 General	14
6.8.2 Data block header.....	14
6.8.3 Data block contents	14
6.8.4 Blank separator.....	14
6.8.5 Assignment connector.....	14
6.8.6 Object pointer	15
6.8.7 Compound	15
7 Incremental model.....	16
7.1 General.....	16
7.2 Structure of incremental model	16
7.3 Data block of incremental model.....	17
8 CIM/E Schema	18
8.1 General.....	18
8.2 Schema structure	18
8.3 Class description.....	19
8.4 Enumeration block	19
8.5 Compound type.....	20
9 Usage	21
Annex A (informative) The example of CIM/E	22
Annex B (informative) Mapping CIM/E to CIM/XML	23
Bibliography	24
Figure 1 – Interconnection power grid	9
Figure 2 – CIM model exchange and merge.....	9
Figure 3 – Online dynamic stability analysis	10

Figure 4 – Model exchange mechanism based on CIM/E	11
Figure 5 – Transverse-table structure	12
Figure 6 – Vertical-table structure	12
Figure 7 – Usage example of object pointer	15
Figure 8 – Usage example of compound type	15
Figure 9 – The 1st form of incremental model description format.....	16
Figure 10 – The 2nd form of incremental model description format.....	17
Figure 11 – CIM/E schema description	18
Figure 12 – The multiplicity in class definition.....	19
Figure 13 – The example of enumeration definition.....	20
Figure 14 – Example of compound attribute definition	20
Figure A.1 – An example of CIM/E	22
Table 1 – Symbol definitions	10
Table B.1 – Mapping CIM/E to CIM/XML.....	23

is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENERGY MANAGEMENT SYSTEM APPLICATION
PROGRAM INTERFACE (EMS-API) –****Part 555: CIM based efficient model exchange format (CIM/E)**

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. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 61970-555, which is a technical specification, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
57/1730/DTS	57/1769/RVC

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

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

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 publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

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.

INTRODUCTION

This part of IEC 61970, which is a technical specification, describes 'CIM-E', an alternative to IEC 61970-552 (CIM/XML) for serializing CIM data exchanges, which is in use in China. It is a general method of serialization that could be used with any defined exchange, but it was developed specifically as an alternative to IEC 61970-552 for exchanging power system network models and solutions, which are defined in IEC 61970-452 and IEC 61970-456. Following is an explanation as to why the IEC has formally documented this method in addition to IEC 61970-552.

When the IEC first developed its standard for exchanging power system models, the primary model exchange specification, IEC 61970-452, described exchange of a complete model. The companion standard, IEC 61970-552, specified how to serialize model data for exchange, and also described how to serialize 'incremental updates' of a model in which only changed parts are exchanged. This latter feature was included because complete models could be very large and require significant processing time, but in most real business situations, model transfers are updates of previous exchanges in which only small parts of the models have changed. Unfortunately, while the IEC understood the potential value of incremental processing, no 'use cases' were produced to document the situations in which full or incremental processing would be recommended.

At the time that the IEC was producing these documents, China was following the development of CIM standards and planning to use them. The situations in which they wanted to use CIM model exchange demanded high performance. The solution they chose was CIM-E, a more compact version of serialization than CIM/XML, which their applications could process quickly.

As time passed, the IEC expanded its set of exchanges to include solved cases and continued to envision incremental updates as the approach for optimizing performance. China began to participate actively in WG 13 meetings, and also continued to enhance the CIM-E serialization method, which is a national standard now in China.

In 2011, China proposed that IEC adopt CIM-E as a standard. The IEC concluded that a CIM-E specification was appropriate. China represents a significant part of the world's electricity infrastructure. It is using CIM. The IEC therefore felt that an IEC specification for CIM-E would be useful, provided that it simply presented a specification for meeting a requirement for CIM-E exchange and did not endorse CIM-E as the recommended method for achieving high performance.

The IEC 61970 series defines an Application Program Interface (API) for an Energy Management System (EMS).

IEC 61970-301 specifies a Common Information Model (CIM): a logical view of the physical aspects of electric utility operations. The CIM is described using the Unified Modeling Language (UML), a language used to specify, visualize, and document systems in an object-oriented manner. UML is an analysis and design language; it is not a programming language. For software programs to use the CIM it needs to be transformed into a schema form that supports a programmable interface.

This part of IEC 61970 describes the translation of the CIM in UML form into a machine readable format as expressed in CIM based Efficient Model Exchange Format(CIM/E) representation of that schema using the CIM/E Schema.

This part of IEC 61970 specifies how the CIM/E schema is used to support power system models or particular application data models exchange requirements, especially for real-time or online applications. Similar to CIM/XML, CIM/E is an efficient serialization format to describe CIM objects. The power system model described by CIM/E or by CIM/XML can be converted bi-directionally with consistent result.

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

Part 555: CIM based efficient model exchange format (CIM/E)

1 Scope

This part of IEC 61970, which is a technical specification, specifies a Component Interface Specification (CIS) for Energy Management Systems Application Program Interfaces. This part specifies the format and rules for exchanging modelling information based upon the CIM. It uses the CIM/E Schema as the meta-model framework for constructing CIM/E documents of power system modelling information. The style of these documents is called CIM/E format. CIM/E is suitable for use in online model exchange of power system applications.

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 61970-452, *Energy management system application program interface (EMS-API) – Part 452: CIM model exchange specification*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

Application Program Interface API

the set of public functions provided by an executable application component for use by other executable application components

3.2

Common Information Model CIM

abstract model that represents all the major objects in an electric utility enterprise typically contained in an EMS information model

Note 1 to entry: By providing a standard way of representing power system resources as object classes and attributes, along with their relationships, the CIM facilitates the integration of EMS applications developed independently by different vendors. It provides a common information presentation between EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management.