

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Power systems management and associated information exchange –  
Interoperability in the long term –  
Part 100: CIM profiles to XML schema mapping**

**Gestion des systèmes de puissance et échanges d'informations associés –  
Interopérabilité à long terme –  
Partie 100: Mapping des profils CIM avec le schéma XML**



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 33.200

ISBN 978-2-8322-3454-9

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**POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION  
EXCHANGE – INTEROPERABILITY IN THE LONG TERM –**

**Part 100: CIM profiles to XML schema mapping**

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International Standard IEC 62361-100 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This is the first edition of the standard.

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

FDIS	Report on voting
57/1704/FDIS	57/1735/RVD

Full information on the voting for the approval of this 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.

In this document, the following print types are used:

- Words printed in **Arial Black** apply to terms that are defined as contextual model artefacts in 4.4.2,
- Words printed `Courier New` apply to terms that are used as XML Schema representation (as defined in 4.6) or in XML examples,
- Words printed “between quotes” apply to terms that are used as tokens in the normative clauses or that are defined as CIM artefacts.

A list of all parts of the IEC 62361 series, under the general title: *Power systems management and associated information exchange – Interoperability in the long term*, can be found on the IEC website.

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## INTRODUCTION

The IEC 62361 series defines standards which address areas of interest that impact multiple standards and provide consistency for implementations.

This part of the IEC 62361 series describes a mapping from CIM profiles to W3C XML Schemas and defines the rules that CIM XML message payloads shall adhere to.

The principle objective of this part of IEC 62361 is to facilitate the exchange of information in the form of XML documents whose semantics are defined by the IEC CIM and whose syntax is defined by a W3C XML schema. This will facilitate the integration of all applications that use the XML Schema message payloads developed by the WGs and implemented independently by different vendors into their systems.

The common information model (CIM) specifies the basis for the semantics for message payload exchanges defined by the IEC. The profile specifications, which are contained in other parts of the IEC 62361 series, specify the content of the message payloads exchanged. The format/syntax of those payloads is specified in this part of IEC 62361.

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# POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE – INTEROPERABILITY IN THE LONG TERM –

## Part 100: CIM profiles to XML schema mapping

### 1 Scope

This part of IEC 62361 describes a mapping from CIM profiles to W3C XML Schemas.

The purpose of this mapping is to facilitate the exchange of information in the form of XML documents whose semantics are defined by the IEC CIM and whose syntax is defined by a W3C XML schema.

### 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) 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* <https://standards.iteh.ai/catalog/standards/sist/b8d2f8e9-6f88-43df-bcaf-81ae4575fd84/iec-62361-100-2016>

IEC 61970-301, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

IEC 62325-301, *Framework for energy market communications – Part 301: Common information model (CIM) extensions for markets*

IEC 62325-450:2013, *Framework for energy market communications – Part 450: Profile and context modelling rules*

XML Schema Part 1: Structures Second Edition W3C Recommendation 28 October 2004

IETF RFC 3986 Uniform Resource Identifier (URI): Generic Syntax January 2005

Semantic Annotations for WSDL and XML Schema W3C Recommendation 28 August 2007

### 3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC TS 61970-2 apply, as well as the following.

NOTE Refer to the International Electrotechnical Vocabulary, IEC 60050, for general glossary definitions.

#### 3.1 artefact

element of a model that represents objects of a given domain and their characteristics

### 3.2

#### **canonical model**

abstract model that represents all the major objects of a given domain (energy, electricity...) with artefacts

### 3.3

#### **common information model**

##### **CIM**

canonical model (abstract model) that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility

Note 1 to entry: CIM is defined in the IEC 61968, IEC 61970 and IEC 62325 series.

Note 2 to entry: This note applies to the French language only.

### 3.4

#### **contextual model**

restricted subset of CIM artefacts

### 3.5

#### **extensible markup language**

##### **XML**

markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable

Note 1 to entry: This is defined in the XML Specification produced by the World Wide Web Consortium (W3C).

Note 2 to entry: This note applies to the French language only.

### 3.6

#### **profile**

uniquely named subset of CIM classes, associations and attributes needed to accomplish a specific type of interface

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Note 1 to entry: A profile, as used in this document, is defined in IEC 62325-450:2013 and IEC 62361-101<sup>1</sup>.

### 3.7

#### **resource description format**

##### **RDF**

family of World Wide Web Consortium (W3C) specifications originally designed as a metadata data model

Note 1 to entry: This term has come to be used as a general method for conceptual description or modelling of information that is implemented in web resources, using a variety of syntax formats.

Note 2 to entry: This note applies to the French language only.

### 3.8

#### **semantic annotation for WSDL and XML Schema**

##### **SAWSDL**

set of extension attributes for the Web Services Description Language (WSDL) and XML Schema definition language

Note 1 to entry: This note applies to the French language only.

---

<sup>1</sup> Under consideration.

### 3.9 unified modelling language UML

formal and comprehensive descriptive language with diagramming techniques used to represent software systems, from requirements analysis, through design and implementation, to documentation

Note 1 to entry: UML is a standard defined by the Object Management Group (OMG). UML is used to describe CIM.

Note 2 to entry: This note applies to the French language only.

### 3.10 uniform resource indicator URI

string of characters used to identify a name or a resource, enabling interaction with representations of the resource over a network (typically the World Wide Web) using specific protocols

Note 1 to entry: Schemes specifying a concrete syntax and associated protocols define each URI.

Note 2 to entry: This note applies to the French language only.

### 3.11 XML Schema

family of World Wide Web Consortium (W3C) specifications, used to define the structure, content, and semantics of extensible Markup Language (XML) files

Note 1 to entry: XML Schemas are generally found in files with an "xsd" extension. XSD files are used to define inter-application messages.

### 3.12 Web Ontology Language OWL

family of knowledge representation languages for authoring ontologies, characterised by formal semantics and RDF/XML-based serializations for the Semantic Web

Note 1 to entry: OWL is endorsed by the World Wide Web Consortium (W3C).

Note 2 to entry: This note applies to the French language only.

## 4 System context

### 4.1 Profiling process

The profiling process aim is to define a syntactic model that will govern instance data that are exchanged in a given business context and whose semantic is defined by a canonical model (like CIM). The profiling process is in simple form a two steps process:

- Defining a contextual model that is a subset of the canonical model (subset that could include some restrictions). In this document, there is no assumption about the rules that are used to complete this step, but the contextual model artefacts are described in Table 1.
- Generating a syntactic model in the form of an XML Schema with a defined mapping of contextual model artefacts: this is the purpose of this standard IEC 62361-100.

IEC 62361-100 defines how a contextual model artefact is mapped to XML Schema artefacts (like `element`, `simple` and `complex` types). It does not define a mapping from canonical model artefacts to XML Schema ones, but it keeps the fact that there is relation between these two artefacts.

## 4.2 CIM

CIM is a canonical model that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. This model includes public classes and attributes for these objects, as well as the relationships between them. Classes, attributes, relationships and attribute types like "Primitive", "enumeration", "CIMdatatype" and "Compound" are the main CIM artefacts.

CIM is defined by IEC standards IEC 61968-11, IEC 61970-301 and IEC 62325-301.

The CIM may be augmented with project or application-specific extensions. In that case, the references to the CIM in this subclause can be read as CIM with extensions.

## 4.3 Contextual model

The concept of a contextual model is borrowed from the UN/CEFACT modelling approach and may be used in CIM standards formation. The contextual model may be any one of several formats including OWL or a UML subset package.

No specific contextual modelling language is assumed by this specification. However, the artefacts defined in Table 1 are used in this document when referring to the contextual model and are assumed to be capable of expression in whichever language is used.

The mapping specifications (see Clause 5) apply to these contextual model artefacts which could be represented in a number of languages. Two possible representations are given in the appendices.

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## 4.4 Contextual model artefacts

### 4.4.1 Contextual model artefacts and CIM subset

In Table 1, contextual artefacts are defined in relation to CIM artefacts. Here, the term subset is used: a contextual artefact is a subset of some CIM artefact. Subset means that a contextual artefact could have the same characteristics as its CIM counterpart or a subset of these characteristics. Examples:

- "IdentifiedObject" class in CIM has four attributes ("mRID", "aliasName", "name" and "description") and one association "Names", i.e. its characteristics. "IdentifiedObject" **structured class** in contextual model could have the same characteristics as its CIM counterpart or just some of them: so "IdentifiedObject" contextual artefact is defined as a subset of "IdentifiedObject" CIM artefact.
- "name" attribute of CIM "IdentifiedObject" class has two characteristics: a cardinality that is optional and a type that is a string. In contextual model, "name" **simple property** of "IdentifiedObject" **structured class** could have the same characteristics as its CIM counterpart or some more restricted ones: example, cardinality of "name" could be restricted to mandatory and/or string length could be defined. So "name" contextual artefact is defined as a subset of "name" CIM artefact.
- "Names" association end role name of CIM "IdentifiedObject" has one characteristic: a cardinality that is 0 to many. In contextual model, "Names" **object property** of "IdentifiedObject" **structured class** could have the same characteristic as its CIM counterpart or a more restricted one: example, cardinality of "Names" could be restricted to 1 or 1 to many. So "Names" contextual artefact is defined as a subset of "Names" CIM artefact.

### 4.4.2 Contextual model artefacts definition

Contextual model artefacts are listed and defined in Table 1.

**Table 1 – Contextual model artefacts**

Contextual model artefact	Definition
<b>Structured class</b>	<p>subset of a CIM class not stereotyped with "enumeration", "Primitive", "CIMDatatype" or "Compound".</p> <p>A structured class may have zero or more object properties, compound properties and simple properties.</p> <p>Any subclass of a structured class is also a structured class.</p>
<b>Superclass</b>	<p>relative to a given structured class, a more general structured class whose extent is a superset of the given structured class.</p>
<b>Subclass</b>	<p>relative to a given structured class, a more specific structured class whose extent is a subset of the given structured class.</p>
<b>Root class</b>	<p>structured class that may have standalone instances which are not the referent of any object property.</p> <p>A contextual model may assign cardinality bounds to a root class limiting the number of standalone instances that may occur.</p>
<b>Union class</b>	<p>subset of a non-stereotyped CIM superclass defined as a union of (some of) its subclasses.</p> <p>Each member of the union is defined as a structured class. Each of these is a subclass of a single, given CIM class.</p> <p>An instance of a union is an instance of one of its constituent structured classes.</p> <p>Example: in CIM, "RegisteredResource" is a super class of "RegisteredLoad", "RegisteredTie" and "RegisteredGenerator". In contextual model, "RegisteredResource" could be a super class of some of these subclasses. When defined as a union, "RegisteredResource" defined the set of the subclasses ("RegisteredLoad", "RegisteredTie"... ) that are going to be used as the referent classes for the "RegisteredResource" <b>object property</b> that in this case will be a <b>union object property</b> (see below).</p> <p>Note: this feature is used to get all the elements representing subclasses instances in a random order.</p>
<b>Compound class</b>	<p>subset of a CIM class defined as "Compound" with additional restrictions.</p> <p>An instance of a compound class is a structured value. It has one or more properties, but it has no identity distinct from the combination of its property values.</p>
<b>Basic type</b>	<p>CIM class defined as a "Primitive" (include "Integer", "Decimal", "Boolean", "Duration", "DateTime", "Date", "Time", "Float", "String").</p> <p>A subset of the CIM "Float" class defined as a "Primitive" and marked as "Single" or "Double" precision.</p> <p>A subset of the CIM "String" class defined as a "Primitive" and marked as "normalized", "token", "NMTOKEN", "Name", "NCName" and "anyURI" .</p> <p>A basic type may be used directly in a contextual model without further definition.</p> <p>The value range of each basic type is assumed to be that of the XML Schema Part II Datatype integer, decimal, boolean, duration, datetime, date, time, float, double, string, normalizedString, token, MNTOKEN, Name, NCName and anyURI respectively.</p>
<b>Simple type</b>	<p>subset of a CIM class defined as "Primitive" with additional restrictions.</p> <p>As defined above, the value range of such a CIM class is assumed to be one of the XML Schema Part II datatypes defined above.</p> <p>The additional restrictions narrow this value range by defining one or more facets for that datatype (example: "TwentyFourChar_String" is a string whose maximum length is 24 characters).</p> <p>A simple type instance does not have simple properties or object properties and has no identity distinct from its value.</p>

Contextual model artefact	Definition
<b>Data type</b>	<p>subset of a CIM class defined as "CIMDatatype" with additional restrictions.</p> <p>A <b>data type</b> is a class whose instances carry a value and other properties that give meaning to this value. Data type value and other data type properties could be restricted by additional constraints.</p> <p>An instance of a <b>data type</b> class is a structured value. It has one or more properties, but it has no identity distinct from the combination of its property values.</p>
<b>Enumeration class</b>	subset of an "enumeration" CIM class.
<b>CodeList class</b>	<p>subset of an "enumeration" CIM class and marked as "CodeList".</p> <p>Each instance of the enumeration is associated to a "code" whose type is one of the "<b>Basic type</b>".</p>
<b>Simple property</b>	subset of a CIM class attribute with additional restrictions. The type of a <b>simple property</b> is a <b>Simple type</b> , a <b>Basic type</b> , a <b>Data type</b> or an <b>Enumeration Class</b> .
<b>Compound property</b>	subset of a CIM class attribute whose referent is a class defined as a "Compound".
<b>Object property</b>	<p>subset of a CIM association with additional restrictions and a specific direction from referring class to referent class.</p> <p>The referent of an <b>object property</b> is an instance of a <b>structured class</b>.</p> <p>The restrictions may narrow the referring or referent classes or place bounds on the cardinality of the object property.</p>
<b>By-reference object property</b>	<p>subset of a CIM association as per object property, defined as <b>by-reference</b>. The referent of a <b>by-reference object property</b> is either an instance of a structured class or an external instance.</p> <p>An external instance is assumed to exist but is not described in the present message.</p> <p>Pragmatically, a "<b>by-reference object property</b>" is implemented by quoting the referent's identifier (example "mRID").</p>
<b>Union object property</b>	<p>object property defined as <b>union</b> whose referent class is a super class or an object property whose referent class is a union class.</p> <p>In CIM, "ResourceCapacity" has an association with "RegisteredResource", super class of "RegisteredLoad", "RegisteredTie" and "RegisteredGenerator". The association has two end role names: "ResourceCapacity" and "RegisteredResource". In contextual model, "ResourceCapacity" could have the <b>object property</b> "RegisteredResource" whose referent class is "RegisteredResource". If this object property is marked as <b>union</b> or if the "RegisteredResource" referent class is marked as <b>union</b>, then the "RegisteredResource" <b>object property</b> is a <b>union object property</b>.</p> <p>Note: this feature is used to get all the elements representing subclasses instances in a random order.</p>
<b>Exclusive property group</b>	restriction on a <b>structured class</b> with respects to a group of properties such that only one of the properties may appear in a given instance of the class.
<b>BasedOn property</b>	relation between a contextual model artefact (like <b>structured class</b> , <b>property</b> , <b>simple type</b> or <b>data type</b> ) with its corresponding CIM artefact (like "class", "attribute", "association", "Primitive", "enumeration", "CIMDatatype", "Compound").
<b>Documentation</b>	prose description accompanying a definition in the CIM or the contextual model.
<b>Categorized documentation</b>	prose description accompanying a definition in the CIM or in the contextual model together with some classifying properties which indicate the category and purpose of the description.