BS EN IEC 61968-13:2021



BSI Standards Publication

Application integration at electric utilities — System interfaces for distribution management

Part 13: Common distribution power system model profiles

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National foreword

This British Standard is the UK implementation of EN IEC 61968-13:2021. It is identical to IEC 61968-13:2021. Together with BS EN IEC 61169-60:2021, it supersedes BS EN 61968-13:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected

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EN IEC 61968-13

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Supersedes EN 61968-13:2008 and all of its amendments and corrigenda (if any)

English Version

Application integration at electric utilities - System interfaces for distribution management - Part 13: Common distribution power system model profiles (IEC 61968-13:2021)

Intégration d'applications pour les services électriques - Interfaces système pour la gestion de la distribution - Partie 13: Profils de modèle commun de système électrique de distribution (IEC 61968-13:2021)

Integration von Anwendungen in Anlagen der Elektrizitätsversorgung - Systemschnittstellen für Netzführung - Teil 13: Allgemeine Profile zur Modellierung von Verteilnetzen (IEC 61968-13:2021)

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European foreword

The text of document 57/2311/FDIS, future edition 2 of IEC 61968-13, 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 61968-13:2021.

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) 2022-01-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-04-20

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Endorsement notice

The text of the International Standard IEC 61968-13:2021 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61970-600-1[1]	NOTE	Harmonized as EN IEC 61970-600-1[2]
IEC 61970-600-2[3]	NOTE	Harmonized as EN IEC 61970-600-2[4]
IEC 61968-1	NOTE	Harmonized as EN IEC 61968-1
IEC 61970-456	NOTE	Harmonized as EN IEC 61970-456
IEC 61970-453	NOTE	Harmonized as EN 61970-453
IEC 61968-4:2019	NOTE	Harmonized as EN IEC 61968-4:2019 (not modified)
IEC 61968-8:2015	NOTE	Harmonized as EN 61968-8:2016 (not modified)
IEC 60909 (series)	NOTE	Harmonized as EN 60909 (series)
IEC 61850-7-3	NOTE	Harmonized as EN 61850-7-3
IEC 61968-3	NOTE	Harmonized as EN IEC 61968-3
IEC 62559-2:2015	NOTE	Harmonized as EN 62559-2:2015 (not modified)

[1] Under preparation. Stage at the time of publication: IEC PRVC 61970-600-1:2020.

[2] Under preparation. Stage at the time of publication: FprEN IEC 61970-600-1:2021.

[3] Under preparation. Stage at the time of publication: IEC PRVC 61970-600-2:2020.

[4] Under preparation. Stage at the time of publication: FprEN IEC 61970-600-2:2021.

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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.

Publication	Year	Title	EN/HD	Year
IEC/TS 61968-2	-	Application integration at electric utilities - System interfaces for distribution management - Part 2: Glossary	-	-
IEC 61968-11	2013	Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution	EN 61968-11	2013
IEC 61970-301	2020	Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base	EN IEC 61970-301	2020
IEC 61970-452	-	Energy management system application program interface (EMS-API) - Part 452: CIM static transmission network model profiles	EN 61970-452	-
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	2016	Energy management system application program interface (EMS-API) - Part 552: CIMXML Model exchange format	EN 61970-552	2016
IEC 62325-301	-	Framework for energy market communications - Part 301: Common information model (CIM) extensions for markets	EN IEC 62325-301	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 13: Common distribution power system model profiles

FOREWORD

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International Standard IEC 61968-13 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2008. This edition constitutes a technical revision. This edition was pre-tested during 2016 ENTSO-E interoperability tests [1][1]. The interoperability test report mentions: "Some vendors demonstrated that the transformation between distribution network and CGMES is possible. This is a first step towards the efforts to have closer integration between CGMES and profiles for exchanging distribution data (CDPSM)."

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1 Numbers in square brackets refer to the bibliography.

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

a) Alignment with "CIM100" UML version fixed in July 2018:
iec61970cim17v24_iec61968cim13v05_iec62325cim03v14.eap
Namespace associated to this version was: http://iec.ch/TC57/2017/CIM-schema-cim100#

b) Test of Data Sets against "CIM100" version given in a).

c) Test of Data Sets against a newer "CIM100" version of May 2019:
iec61970cim17v34_iec61968cim13v12_iec62325cim03v17a.eap
Namespace associated to this version was: http://iec.ch/TC57/CIM100#

d) Alignment with "CIM100" after CDV stage in order to align 61968-13 with the latest CIM version iec61970cim17v38_iec61968cim13v12_iec62325cim03v17a. A new alignment was done in March/April 2020 on a new CIM100:
iec61970cim17v38_iec62968cim13v13_iec62325cim03v17a.eap. This document has been properly updated with latest developments to minimize the need for any convergence.

e) Test of Data Sets were validated against the profiles derived from these two newer versions of CIM100 in order to guarantee consistency. Validation include syntax validation, and load flow calculation.

f) Informative extensions included (NEK, EDF) which are based on some utility needs, which shall be discussed and which could be integrated in the IEC CIM model. These extensions have been put in a dedicated annex. These extensions will be discussed in IEC TC 57, and eventually be put in the official CIM Model. These extensions are managed through specific namespaces and do not block any interoperability test. Amendments to IEC 61968-13 or new parts to IEC 61968-13 will potentially address these "extensions" in the near future (when integrated into the IEC CIM Model).

g) Namespaces and associated URI modified.

h) Use of last CIM Feeder modelling and unbalanced networks modelling artefacts.

i) New annex illustrating CDPSM usage by EDF in H2020 TDX-ASSIST European project.

j) New annex illustrating CDPSM usage by the Norwegian AutoFOS project. The extension is governed by the Norwegian National Committee (NEK).

k) New paragraph and annex illustrating Observability Area concept.

l) Tools that were used are MODSARUS®[2] (Copyright © 2019, EDF R&D contact: modsarus@edf.fr) for Use Case definition (according to IEC 62559-2, IEC SRD 62913-1 methodology) and CDPSM UML profiling. Riseclipse tool was used for Data Set Validation (RiseClipse Web https://rise-clipse.pam-retd.fr/ Rise Clipse Code: https://wdi.supelec.fr/software/RiseClipse/). CIMTool (https://wiki.cimtool.org/) was also used to verify tools compatibility (profiling and data set validation). A modified version of jCleanCim (http://www.tanjakostic.org/jCleanCim/) was used to generate this documentation. Other tools like CimConteXtor and CimSyntaxGen could be used to produce the profiles and documentation. (https://www.cimcontextor.net/).

m) Replacement of Figure 6 on Network Model Management. Introduction of a new informative annex on CDPSM to CGMES conversion, replacing Figure 7 of the CDV document.

2 MODSARUS is the trademark of a product supplied by EDF. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

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

FDIS	Report on voting
57/2311/FDIS	57/2336/RVD

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

A list of all parts in the IEC 61968 series, published under the general title *Application integration at electric utilities – System interfaces for distribution management*, 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 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.

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INTRODUCTION

The organization of IEC 61968-13 is described in Table 1.

Table 1 – Document overview for IEC 61968-13

Clause	Title	Purpose
1	Scope	Scope of IEC 61968-13.
2	Normative references	Define the normative references that the document depends on.
3	Terms and definitions	Define the terms and defintions that are used in the document.
4	Use Case list	Use cases related to CDPSM.
5	Distribution network modelling and CIM related issues resolved	Feeder modelling Partial-phase devices modelling Manage LV cable in Catalog
6	CIM Distribution Network Static Model Profiles	
Informative Annex A	Use Cases	
Informative Annex C	Example of a European CDPSM MV/LV urban and rural network	CDPSM usage and associated satellite image.
Informative Annex D	Example of a European CDPSM MV/LV urban network	CDPSM usage and associated satellite image.
Informative Annex E	Example of a European CDPSM MV Urban and Rural Network	CDPSM usage and associated satellite image.
Informative Annex F	Example of CDPSM usage in H2020 TDX-ASSIST project	CDPSM usage in European project H2020 TDX-ASSIST project.
Informative Annex G	Example of a nuclear distribution network	CDPSM was leveraged to model internal distribution network of Nuclear Power Plant.
Informative Annex H	Observability area concept	The CIM modelling should be able to represent the concept of observability area.
Informative Annex I	CDPSM to CGMES conversion	Illustrates how CDSPM data sets could be transformed in CGMES data sets.
Informative Annex J	Norwegian Electrotechnical Committee (NEK) CDPSM related Use Cases	Describe the use of CDPSM in the context of Autofos project.

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APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 13: Common distribution power system model profiles

1 Scope

This part of IEC 61968 specifies profiles that can be used to exchange Network Models in a Utility or between a Utility and external applications to the utility. This document provides a list of profiles which allow to model balanced and unbalanced distribution networks in order to conduct network analysis (Power flow calculation). Therefore, it leverages already existing profiles (IEC 61970-45x based on IEC 61970-301 (CIM base) or profiles based on IEC 61968-11 CIM extension for Distribution). This document reuses some profiles without any change, or eventually extends them or restricts them. Moreover, it proposes other profiles to reflect Distribution needs.

Use of CIM in Distribution is not a new topic. Several documents can be of interest [13][17][18][19][20]. This document includes informative parts, as CIM model extensions, which could be integrated in future versions of the IEC CIM Model. These extensions have been used by some utilities for utility internal information exchange use cases and to support information exchanges between different market participants like Transmisstion System Operators (TSO), Distributed System Operators (DSO), Distributed Network Operators (DNO) and Significant Grid Users (SGU) including generators and industry (see Annex J for example).

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 TS 61968-2, *Application integration at electric utilities – System interfaces for distribution management – Part 2: Glossary*

IEC 61968-11:2013, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*

IEC 61970-301:2020, *Energy management system application program interface (EMS-API) – Common information model (CIM) base*

IEC 61970-452, *Energy management system application program interface (EMS-API) – Part 452: CIM static transmission network model profiles*

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

IEC 61970-552:2016, *Energy management system application program interface (EMS-API) – Part 552: CIMXML Model exchange format*

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

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3 Terms, definitions and abbreviated terms

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

Where there is a difference between the definitions in this document and those contained in other referenced IEC standards, then those defined in IEC TS 61968-2 shall take precedence over the others listed, and those defined in IEC 61968-13 shall take precedence over those defined in IEC TS 61968-2.

3.1 Terms and definitions

3.1.1
DMS
Distribution Management System
as used in IEC 61968, system consisting of various distributed application components for the utility to manage electrical distribution networks

Note 1 to entry: These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping and facilities management. Standards interfaces are defined for each class of applications identified in the Interface Reference Model (IRM), which is described in Part 1: Interface Architecture and General Requirements.

3.1.2
profile
agreed-upon subset or derived from a specification

Note 1 to entry: A common profile is required for achieving interoperability especially in those cases when a specification could have more than one interpretation and there are probably many optional features

Note 2 to entry: A profile may be more restrictive than the CIM but not less so.

[SOURCE: IEC TR 62361-103:2018, 3.11, modified – Note 2 to entry has been added.]

3.1.3
use case
specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system

Note 1 to entry: There are two types of Use Cases:

– Business Use Cases describe how Business Roles interact to execute a business process. These processes are derived from services, i.e. business transactions, which have previously been identified.

– System Use Cases describe how System and/or Business Roles of a given system interact to perform a Smart Grid Function required to enable / facilitate the business processes described in Business Use Cases. Their purpose is to detail the execution of those processes from an Information System perspective.

Note 2 to entry: Since a Smart Grid Function can be used to enable / facilitate more than one business process, a System Use Case can be linked to more than one Business Use Case.

[SOURCE: IEC SRD 62913-1:2019, 3.1.22, modified – Table 1 has been deleted from Note 2 to entry.]

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3.2 Abbreviated terms

BUC	Business Use Case (Use Case)
CGMES	Common Grid Model Exchange Standard
CIM	Common Information Model
DER	Distributed Energy Resource(s)
DERMS	Distributed Energy Resources Management System
DL	Diagram Layout
DMS	Distribution Management System
DNO	Distribution Network Operator
DSO	Distribution System Operator. Generally a DSO manages an MV/LV network
EQ	Equipement
EHV	Extra High Voltage
EMS-API	Energy Management System Application Program Interface
HV	High Voltage
IEC	International Electrotechnical Commission
LV	Low Voltage
MV	Medium Voltage
RDF	Resource Description Framework
SUC	System Use Case (USE Case)
SGU	Significant Grid User
SV	State Variable
SSH	Steady State Hypothesis
TP	Topology
TSO	Transmission System Operator. Generally a TSO manages an EHV/HV network
UML	Unified modelling language
UUID	Universally unique identifier
XML	eXtended Markup Language
XSD	XML Schema Definition

4 Use Cases list

4.1 Use Cases related to the Common Distribution Power System Model Profiles

Business Processes and the associated interaction between business roles (inside and outside a given domain) can be described as Business Use Cases, Smart Grid Functions and the associated interactions between roles (Business and/or System roles) can be described in System Use Cases according to IEC SRD 62913 (all parts). IEC TR 62357-2 refers to Use Cases presented in this document.

The definition of the Common Distribution Power System Model Profiles (CDPSM) standard is mainly based on the identification of the related Business and System Use Cases and their description using the IEC 62559-2 use case template.

In order to identify the Business Use Cases of interest for CDPSM objectives, firstly an analysis of the BUC (Business Use Cases) collection specified in IEC SRD 62913-2-1:2019 was carried out (see Table 2 – Identified Generic Business Use Cases of the Domain).

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Table 2 – Identified Business Use Cases

Identified Business Use Cases	Brief description
Elaborate the distribution network multiannual masterplan	The Business Use Case describes how the HV and MV/LV System Operator elaborates the network multiannual masterplan by simulating constraints likely to appear on the network and prioritise network investments. *This Business Use Case is generic and applied to the European region*
Optimise network operations in operational planning based on a schedule	The Business Use Case describes how the HV and MV/LV System Operator anticipates / optimises network operations in medium-term (month and week ahead) and short-term (day ahead and intraday) operational planning. It consists of: – anticipating the operating points based on local load and generation forecasts, identify and qualify risks of constraints on the network (primary substation, MV network, and HV network if managed by the HV and MV/LV System Operator), – defining the network configuration in order to satisfy the contractual commitments, with the use of several optimisation levers which aim at solving detected constraints at the lowest cost, – taking into consideration for all timeframes the work programmes, – taking into consideration real-time network constraints (faults, transmission limitation or transmission outage, load transfers) and evaluating the impact on the operating points. *This Business Use Case is generic and applied to the European region*
Optimise work programmes (EHV and HV System Operator, Producers, and HV and MV/LV System Operator works)	The Business Use Case describes how the HV and MV/LV System Operator optimises work programmes on the HV and MV networks, i.e. schedules for operations related to the creation, maintenance, and repair of network assets – including works determined by the EHV and HV System Operator, HV and/or MV Producers, and the HV and MV/LV System Operator – in order to minimise their impact on the system and maximise renewable energy. *This Business Use Case is generic and applied to the European region*
Decide asset renewal priorities and optimise maintenance programmes	The Business Use Case describes how the System Operator decides asset renewal priorities and optimises maintenance programmes in the planning phase, based on the network assets analysis and the development of failure predictive and condition-based maintenance models. *This Business Use Case is generic and applied to the European region*
Decide to carry out urgent maintenance operations	The Business Use Case describes how the HV and MV/LV System Operator analyses network assets health indexes using archived data (assets use, maintenance operations, faults, voltage excursions…) and real-time data monitoring. Based on this information, the HV and MV/LV System Operator evaluates the risk of default and decides to carry out urgent maintenance operations to prevent faults. *This Business Use Case is generic and applied to the European region*
Operate the MV network in real-time in an optimised way using new automations and advanced functions	The Business Use Case describes how the MV/LV System Operator manages the MV network in real-time by optimising the configuration of the network, while ensuring coordination with the EHV-HV System Operator, maintaining voltage profile within acceptable limits, preventing critical situations using emergency levers, and restoring supply in case of faults. *This Business Use Case is generic and applied to the European region*
Monitor and manage the LV network	The Business Use Case describes how the MV/LV System Operator manages the LV network in real-time in normal conditions and in case of faults to maintain quality and continuity of supply, using for instance data from smart meters and other equipment installed on the network. *This Business Use Case is generic and applied to the European region*

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Identified Business Use Cases	Brief description
Optimise grid operating conditions using available levers (LV phase balance optimisation and off-line MV/LV tap changers)	The Business Use Case describes how the HV and MV/LV System Operator performs load flow calculations based on archived metered, network and weather data and optimises: – the set point of the off line MV/LV tap changers, – the grid connection requirements, – the grid connection phase of single-phase meters which are already connected or to be connected to the LV network. This allows the HV and MV/LV System Operator to prevent network constraints and increase grid capacity. *This Business Use Case is generic and applied to the European region*
Electrical Data Management in Nuclear Power Plants	Electrical data in nuclear power plants have to be managed, from the engineering studies to operation and maintenance. The electrical distribution grid of a nuclear power plant is substantial and shall be managed carefully for safety reasons. Nuclear power plants have to be stopped regularly for refueling and maintenance (unit outage). The goal of nuclear utilities is to keep these unit outages as short as possible, in order to optimize the energy availability factor. The unit outages shall then be planned very precisely. Indeed, a lot of work shall be done in parallel, while some cooling circuits need to be preserved for nuclear safety. In this context, it is very important to be able to know (and simulate) which equipment is impacted by the unavailability of a distribution switch board: during planning, in order to optimize the maintenance work and during the unit outage itself, in order to face unexpected events. In addition, engineering teams shall also run simulations for power balance calculations and other network analyses.

The above statement "This Business Use Case is Generic and applied to the European region" is extracted from IEC SRD 62913-2-1. It means that at least Europe implements such a use case, but that it is not specific to Europe. The above Use Cases show that some network models need to be managed and potentially exchanged globally or in-part. These network models can include Asset related information.

From that list the BUC mainly considered for the definition of CDPSM are:

- optimise network operations in operational planning based on a schedule,
- optimise network operations in real-time in an optimised way using new automations and advanced functions.

CDPSM shall support the following requirements extracted from the Business Use Case listed in Table 3.

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Table 3 – Identified requirements

Requirement brief description
The MV/LV system operator, in coordination with the EHV/HV System Operator, Producer and Customer, shall have optimised the configuration of the network before real-time by using operational planning tools and load and generation forecasts at the primary substation level.
The MV/LV system operator, in coordination with the EHV/HV System Operator, Producer and Customer, shall have taken into account the works planned on the MV/LV network and production schedules of Distributed Generators connected to the MV network if available.
The Advanced FLISR System exchanges with MV System Operator: • topological data and real-time operating conditions, • load on Network assets and power flows, • contextual information, • protection plan and Network constraints in real time.
The State estimation function shall integrate in its calculations the real-time network topology (position of switches) and impedances.
In case of a restoration plan requiring a load transfer, from one Primary Substation to another one, greater than a certain threshold, the MV System Operator exchanges information with the EHV/HV System Operator, in compliance with the Network operation contract in force between the two parties.
Several voltage level mixing AC, DC networks shall be managed (case of a nuclear distribution network).

4.2 Use Case overview table

More detailed BUCs related to the CDPSM scope are reported in Table 4.

Table 4 – Business Use Cases related to CDPSM

Name of Use Case	Short description	Actors	General remarks
DSO provides its power system models to TSO	In order to calculate the TSO grid power flow, the DSO provides to TSO an aggregate view of its power system model, including the related states and measurements.	TSO DSO	
A customer provides its DER plant power system models to DSO	A DER connection to the Distribution grid request is supported by the description of an aggregate view of the DER plant power system model.	DSO DER	
DSO1 and DSO2 mutual exchange their power system models	DSO1 and DSO2 mutually exchange their power system models in order to manage the grid in case of outages on a boundary feeder.	DSO1 DSO2	
TSO and DSO provides their power system models to a third party	TSO and DSO provide their power system models to a third party in order to perform an ex-post analysis of a power quality issue (i.e voltage dips).	TSO DSO Authority	
DSO/DNO internal information exchange	A DSO/DNO exchanges various information or data between different systems within the company.	DSO or DNO	
DNOs provide their power system models to DSO	In order to perform network planning, various analyses, outage management, etc., of the whole distribution grid, the DSO needs power system models of the subordinate DNOs grids.	DSO DNO	DNOs own and operate a part of the whole distribution grid for which the DSO is responsible for

In order to support the definition of the CDPSM data requirement related to a concrete scenario, Clause A.2 defines a System Use Case (SUC) related to TSO-DSO information exchange supporting the first BUC listed in Table 4.

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This support also the same Use Case for an EMS: loadflow simulations (SV, SSH), transfer from detailed topology to bus branch model (TP Profile).

It is to be highlighted that the System Use Case supporting the BUC involving DSO and TSO roles defined in Clause A.2, could also be applied for BUCs involving other roles (DSO/DSO, DSO/MicroGridSystemOperator, etc.), since the profile requirements are equivalent. Microgrid use cases are studied in IEC TC 8 (microgrid Energy Management System) and will provide use cases relevant to this document.

5 Distribution network modelling specificities and CIM related issues resolved

5.1 Feeder modelling

The need/purpose of the feeder model is that a Feeder construct is intended to support naming, user navigation and tracing.

Unlike other CIM containers, which require that objects be contained in only one container, the Feeder is a container that can contain both equipment and other containers.

In order to cover Use Cases such as outage management in a feeder (determine from which feeder load can be transferred), it is necessary to model the feeder with the CIM.

To do this with the current version of the CIM, there is a need to process the network connectivity, starting from the breaker in the primary substation, and following the connectivity chain (conducting equipment, terminals, and connectivity nodes) until the next switch. A different set of rules, depending on utilities, is applied to define the spreading part of network concerned by the connectivity processing.

This is typical to Distribution networks, where networks can be managed as radial.

- Usually one Switch feeds a network part.
- Open Switches serve as borderline with other network parts (used to rescue when a feeder-switch is down).
- To satisfy different detailed level applications, expressing the composition of the feeder should be possible at 2 detail-levels: Containers and elementary equipment.
  - Containers: Substation, Line, VoltageLevel for undetailed definition.
  - ConductingEquipment or ConnectivityNodes for detailed definition.
- Feeders might be hierarchically subdivided (for example a MV-Feeder feeds/includes several LV subnetworks).

One primary substation, having 3 feeders and 5 secondary substations is illustrated in Figure 1.

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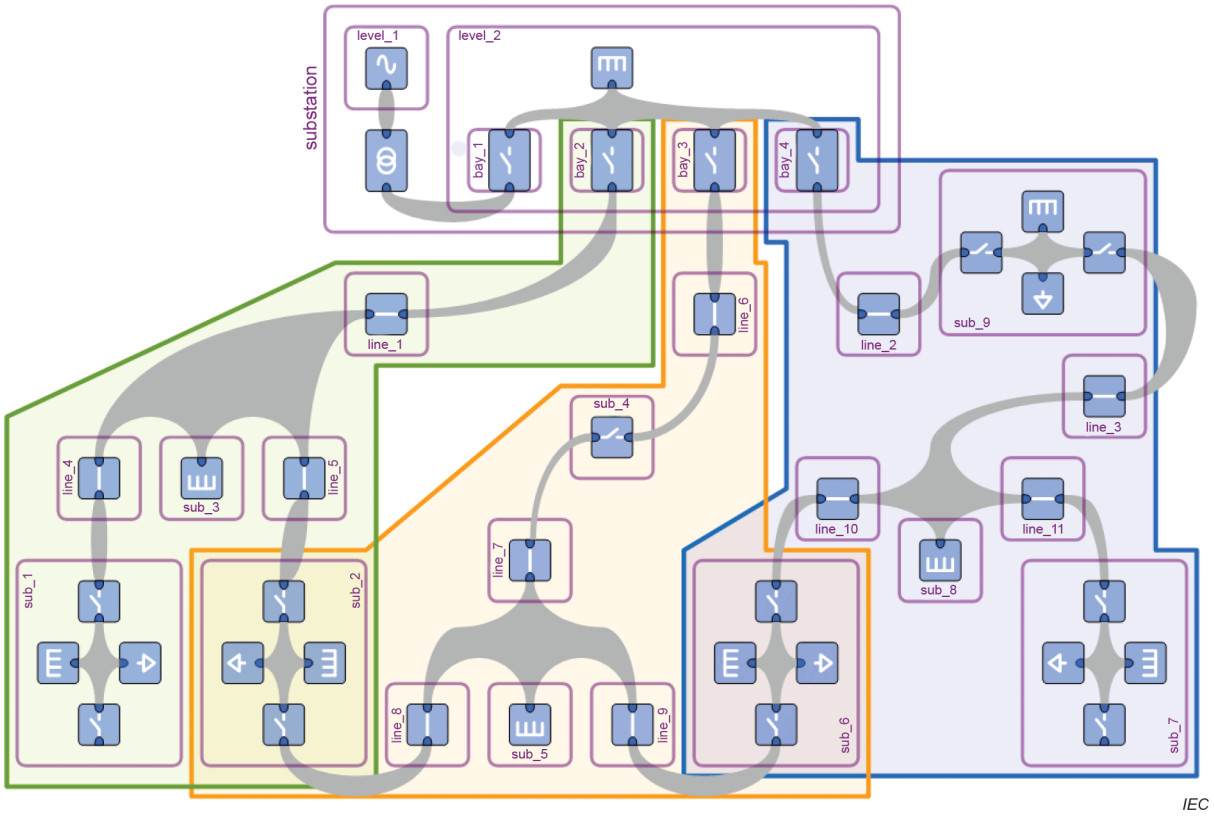


Figure 1 – Feeder containment principles

In the above figure, Substation and Sub_x will use CIM:Substation, Line_x will use CIM:Line, Level will use CIM:Voltage_Level, Bay_x will use CIM:Bay. The different feeders are groups using a colour code (green, yellow, blue). This figure illustrates a MV/LV network, that this document can implement.

The UML CIM Feeder model has been included in the last version of the CIM Model. See associated IEC 61970-301:2020, 4.5.16 and IEC 61970-301:2020, Figure 68.

The tests data sets provided in Annex C, Annex D, Annex E and Annex F have validated this model proposal. This model proposal shall be consolidated through other data sets.

5.2 Partial-phase devices modelling

IEC 61970-301 and IEC 61968-11 already have support for partial phase conducting devices through the PhaseCode enumeration which may be a combination of any or all of the letters A, B, C, and N. In general one can think of a partial phase conducting device as being the same as a full 3-phase device with some of the phases missing.

Impedances of unbalanced and partial phase devices:

IEC 61970-301 specifies impedance of conducting devices in terms of the real and reactive positive and zero sequence impedance. Unfortunately, this is only valid for perfectly symmetric 3-phase networks where all 3 phases have the same value of self-impedance and the same mutual impedance value.

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The impedance of unbalanced 3-phase conducting devices such as AC line segments shall be specified as a three by three complex matrix where the diagonal terms specify the self impedance of each phase and the off-diagonal terms specify the mutual impedance between each phase pair. These values can be computed using Carson's equations based on the geometric mean radius, the linear resistance and the geometric arrangement of the three phases on the pole. For 2-phase devices the impedance matrix is two by two and for single-phase devices it is a complex scalar specifying the self impedance of the single phase conductor.

Refer to IEC 61968-11:2013, 4.4.3 (Network modelling concepts and examples) and IEC 61970-301 for more precise modelling concepts including unbalance modelling concepts.

5.3 Manage LV cables in catalog

LV cables are commonly compounded in a single asset of conductors with different characteristics: three identical conductors for phases, a different conductor to the neutral.

To manage them in catalog, associated with AssetModel, it needs to set an assetinfo subtype that allows the description of these assemblies:

- characteristics (WireInfo) of each of the different type of conductors,
- their respective quantities or assignment to phases/neutral,
- impedances.

(Quantities or phase/neutral assignment are needed to identify clearly which phasing usage can be done, and which WireInfo affects which column if PhaseImpedance by only using the level objects "catalog" without resorting to an ACLineSegmentPhase link).

This applies to underground cables or twisted-assembled overhead use, but it would also be helpful for overhead with single conductors. Good practices mounting rules in several utilities allow a limited amount of opportunities for wires and positions assemblies. As it is more simple and concise to manage a catalog of predefined assemblies, associating them with ACLineSegments, without the need to repeatedly declare ACLineSegmentPhase to distinguish the two different WireInfos needed.

Figure 2 describes a solution which includes informative extensions, which will need to be discussed in IEC TC 57.

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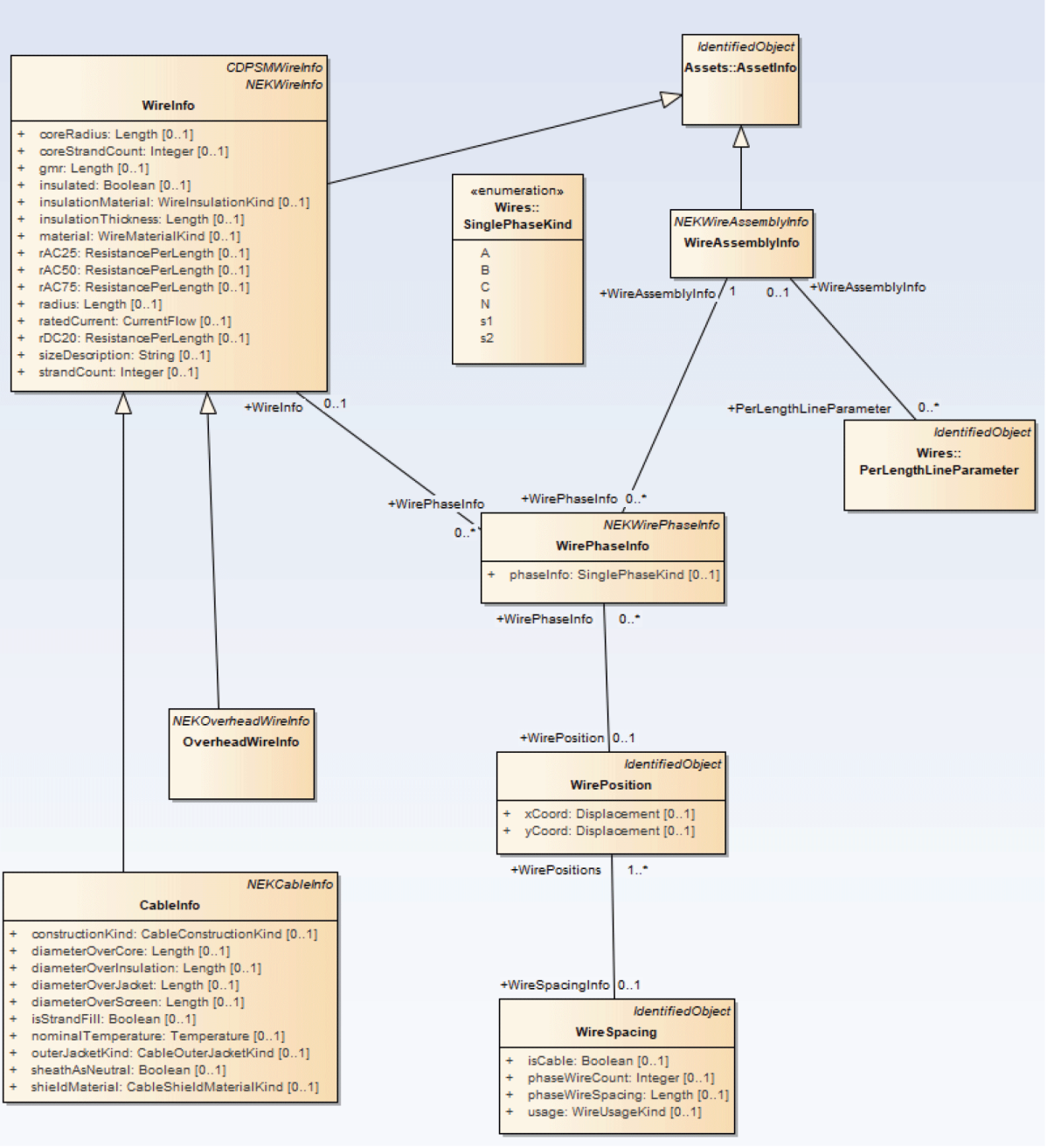


Figure 2 – UML Wire arrangement (informative)

See informative Annex J for background information on proposed extensions.

5.4 Observability Area (informative)

As explained in [3], according to [5], "*each system operator is responsible for its own grid, also called 'responsibility area'. To operate this grid properly, it is important to also know what is happening in part of the surrounding grids. The responsibility area together with this part of surrounding grids that can affect the responsibility area is called the Observability Area*".

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The concept of an Observability Area for each System Operator is the portion of a grid related to a specific operator's grid that affects flows in another operator's grid [6] [7]. This is related to meshed grids as grids connected radially only affect connecting grids on the border. According to this reference, "Observability Area means its own Transmission System and the relevant parts Distribution Networks and neighbouring TSOs' Transmission Systems, on which TSO implements real-time monitoring and modelling to ensure Operational Security in its Responsibility Area". However, the mentioned document only reflects the point of view of the TSOs, which means that from a DSO and third-party point-of-view, not only a Transmission System needs to be considered but the Distribution System is also of great importance on this concept.

In general, an exchange of structural, scheduled and real-time data is necessary since the Observability Area is a key element for the network operation management. Several elements from the System Operators shall be exchanged to achieve security in the operations that affect a grid operator's border. The exchange of information between TSOs, DSOs and other market participants can be included from articles 40 to 53 of the System Operation Guidelines.

See Annex H for more information about the Observability Area concept.

6 CIM Distribution Power System Model Profiles

6.1 General

Subclause 6.1 lists the profiles that will be used for data exchange and the classes, attributes, and associations that are a part of each profile. Included are all the classes that a data consumer would be expected to recognize in the data being consumed. Additional classes are also referenced in this clause when the classes to be exchanged inherit attributes or associations.

The main steps for profiling CDPSM with CIM are presented in Figure 3.

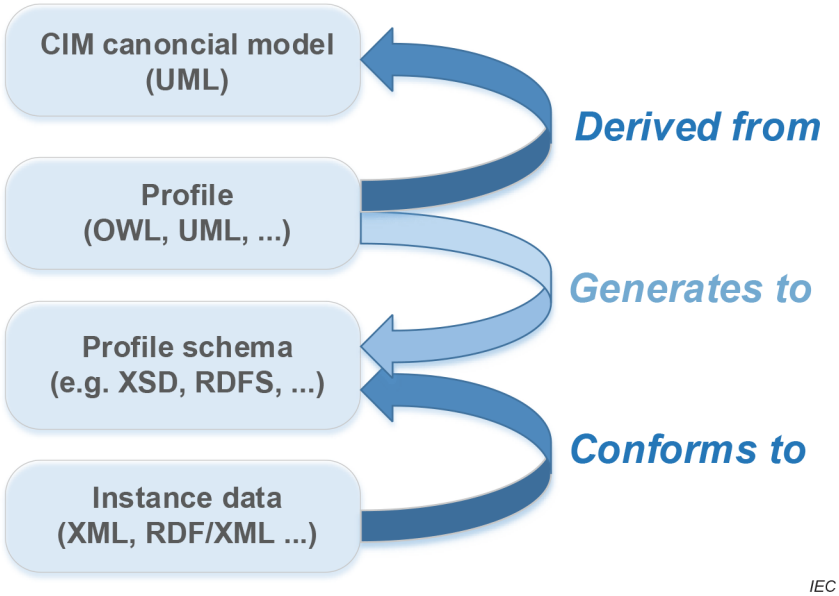


Figure 3 – Main steps for profiling CIM

The CDPSM Profiles described in 6.2 to 7.5 are derived from the CIM Model (IEC 61970-301, IEC 61968-11) as described in Figure 3.

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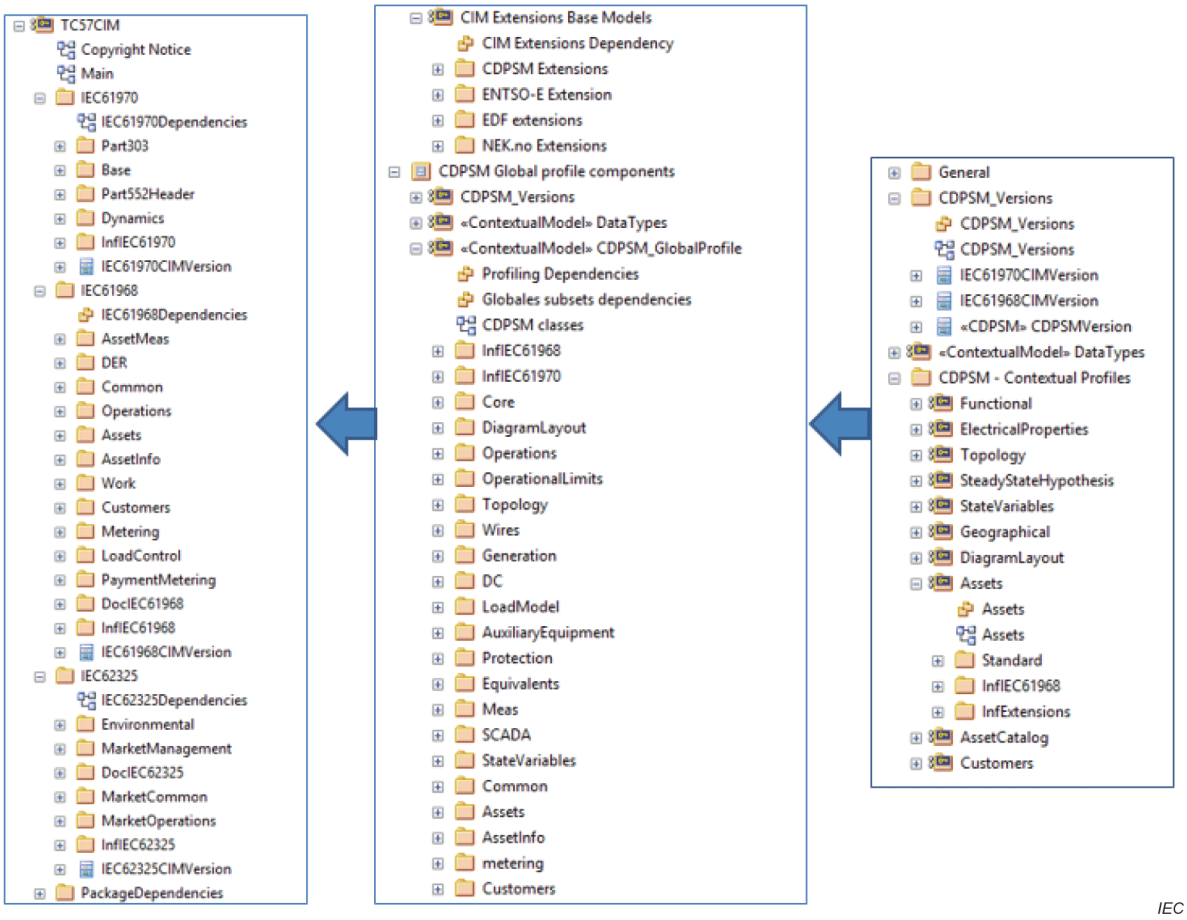


Figure 4 – UML CDPSM profiles (informative)

Figure 4 illustrates how the CDPSM group of profiles is managed, and how profiles are then derived from the CDPSM group of profiles. The CDPSM group of profile is a subset of the IEC TC 57 CIM Model. A group of profiles will result in one associated profile file. A group of profiles can be split into several profiles, each profile associated with one file. In case of profiles, there can exist cross references between these profiles. Extensions are exported in informative Annex B.

Some Extensions shall be taken into account when integrated officially into the IEC CIM model (IEC 61970-301, IEC 61968-11, IEC 62325-301) in future.

The CIM UML version used was: iec61970cim17v24_iec61968cim13v11_iec62325cim03v14.eap. It was identified as CIM100 in June 2018. Then this document was updated and aligned with more recent CIM100 versions: iec61970cim17v38_iec61968cim13v12_iec62325cim03v17a (end of 2019) and iec61970cim17v38_iec61968cim13v13_iec62325cim03v17a.eap (March 2020).

As mentioned in the Foreword, data sets have also been tested against CIM100 versions provided since 2018. The data sets are compliant with IEC 61970-501 and IEC 61970-552.

Convergence will occur between CDPSM 2.0 and the CGMES consolidated version [8][9][10][11] that is based on CIM17/CIM100. The following profiles will evolve according to the convergence process. IEC 61970-452 will also evolve to include Distribution network concerns (and be renamed). The profiles and associated URIs (namespaces) are listed below:

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CIM Standard

Base UML CIM	"http://iec.ch/TC57/ CIM100#"
DataTypes	"http://iec.ch/TC57/CIM100#"

Informative packages in CIM

InfIEC61970	"http://iec.ch/TC57/CIM100-info#"
InfIEC61968	"http://iec.ch/TC57/CIM100-info#"

Extensions (informative)

Entsoe_Extensions_3.1	"http://entsoe.eu/CIM/SchemaExtension/3/1#"
Entsoe_Extensions_3.2	"http://entsoe.eu/CIM/SchemaExtension/3/2#"
CDPSM_Extensions_1.0	"http://iec.ch/TC57/CIM/CDPSM/SchemaExtension/1/0#"
CDPSM_Extensions_2.0	"http://iec.ch/TC57/CIM/CDPSM/SchemaExtension/2/0#"
MSITE_Extensions_3.1.a	"http://der.edf.fr/mire/MSite-v3.1.a#"
NEK_Extensions_1.0	"http://NEK.no/NK57/CIM/CIM100-Extension/1/0#"

Group of profiles for CDPSM2.0

GlobalProfile	"http://iec.ch/TC57/CIM/CDPSM/GlobalProfile/2/0"

CDPSM2.0 profiles

Functional	"http://iec.ch/TC57/CIM/Functional/2/0"
ElectricalProperties	"http://iec.ch/TC57/CIM/ElectricalProperties/2/0"
Geographical	"http://iec.ch/TC57/CIM/Geographical/2/0"
Assets	"http://iec.ch/TC57/CIM/Asset/2/0"
AssetCatalog	"http://iec.ch/TC57/CIM/AssetCatalogue/2/0"
SteadyStateHypothesis	"http://iec.ch/TC57/CIM/SteadyStateHypothesis/2/0"
Topology	"http://iec.ch/TC57/CIM/Topology/2/0"
Customers	"http://iec.ch/TC57/CIM/Customers/2/0"

Profiles Functional, ElectricalProperties, Asset, AssetCatalog and Customers are specific to CDPSM 2.0. Functional and ElectricalProperties are based on IEC 61970-452. Assets, AssetCatalog are based on IEC 61968-4 [22] and Customers is based on IEC 61968-8 [23] Nevertheless they can use classes, attributes, relations which are not listed in these associated documents, but which are at least in the IEC CIM Model of IEC 61970-301, IEC 61968-11 and IEC 62325-325.

Profiles Topology, Geographical, and SteadyStateHypothesis are not identical to CGMES profiles, therefore they are included in CDPSM 2.0. Following CDPSM and CGMES convergence, these profiles might be unique.

Profiles common to CDPSM2.0 and CGMES

StateVariables [14]	"http://entsoe.eu/CIM/StateVariables/4/1"
DiagramLayout [15]	"http://entsoe.eu/CIM/DiagramLayout/3/1"

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Figure 5 illustrates CDPSM interoperability usage between two or several applications that can be hosted by a Utility (GIS/SCADA/Network Operation systems) or hosted by two utilities (like TSO-DSO, DSO-DSO, DSO-SGU). This allows a data synchronisation management between systems. Two systems can exchange data based on CDPSM profiles to align their databases, and then exchange messages based on these reference data which are stored in databases. This figure illustrates the complementarity of IEC 61968-13 with other IEC 61968-X standards, which are message based.

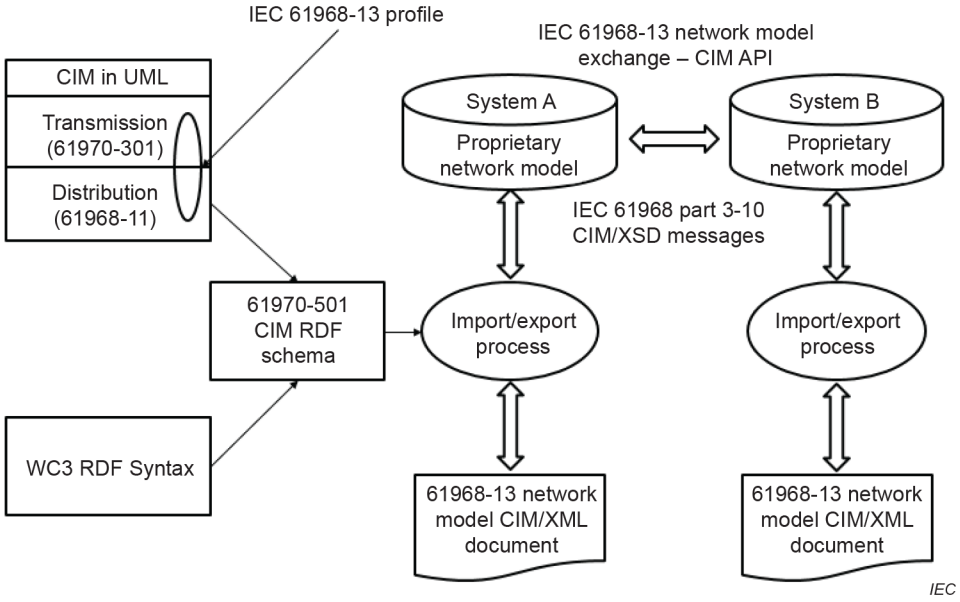


Figure 5 – CDPSM interoperability scheme

Figure 6 illustrates how CDPSM related profiles can be used in a utility environment and by a Network Model Management System.

The Network Model Management [21] will manage Power System Resources and their electrical properties. The properties are default or calculated values held on Power System Resources, usually derived from external data sources, such as datasheets of assets coming from either asset catalogues, or from actual assets. CDPSM related profiles can be provided by GIS system or equivalent to a Network Model Management System.

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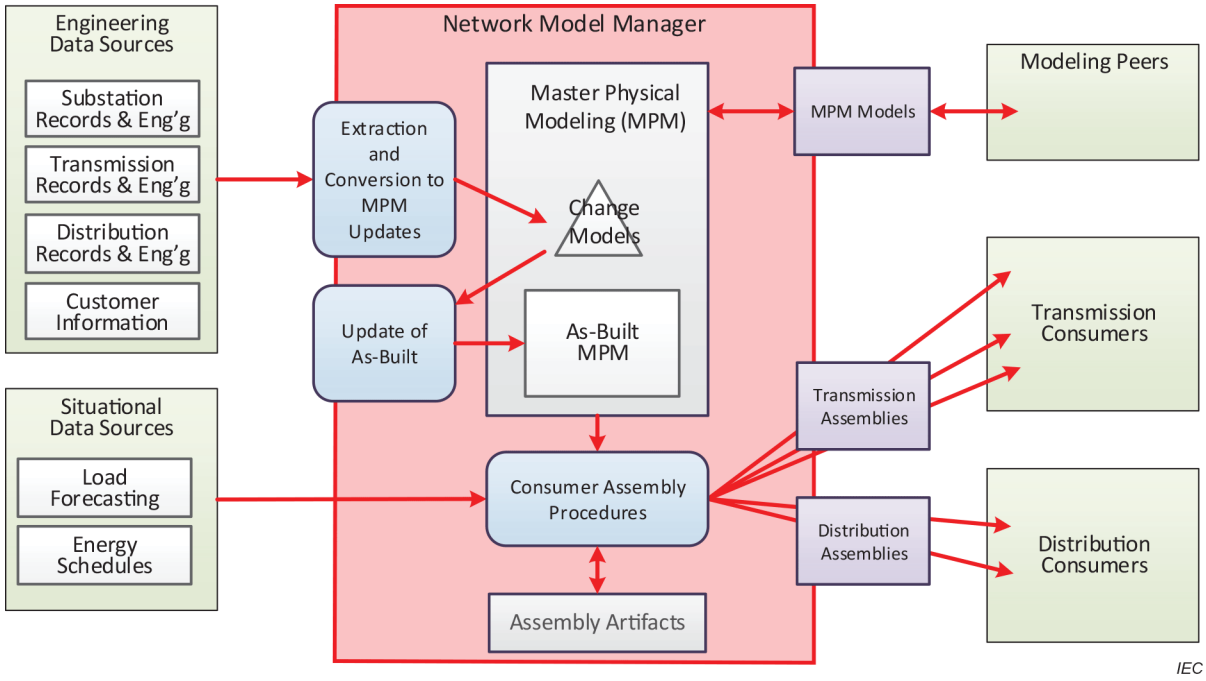


Figure 6 – Network Model Management overview

As some electrical properties can be managed by catalog and AssetInfo, if a topology or Network solution algorithm requires electrical properties for each Equipment related classes, then the individual Network Case will be exported from Network Model Management with a processing on the Data Sets, in order to be in the requested format and to have each electrical property on each equipment.

In Europe, ENTSO-E has defined a Common Grid Model Exchange Standard (CGMES) associated to IEC 61970-600-1 and IEC 61970-600-2, which defines the interface between ENTSO-E members' software in order to exchange power system modelling information as required by the ENTSO-E and TSO business processes. Some profiles, defined by ENTSO-E, are not used by DSOs at the present time. This does not prevent a DSO network Distribution data set compliant with CDPSM profiles from leveraging CGMES profiles implemented by a Vendor product. Annex I illustrates the process.

Some network diagram examples are given in Annex B, Annex C, Annex D, Annex E, and Annex F.

Annex B describes CDPSM extensions (informative).

Annex C, Figure C.1 describes an example of a European CDPSM MV/LV urban network.

Annex D, Figure D.1 describes an example of a European CDPSM MV Urban and Rural Network.

Annex E, Figure E.1 describes an example of CDPSM usage in European H2020 TDX-ASSIST project

Annex F, Figure F.1 describes an example of a Nuclear Distribution Network.

6.2 Top package General

Figure 7 describes CDPSM profiles.

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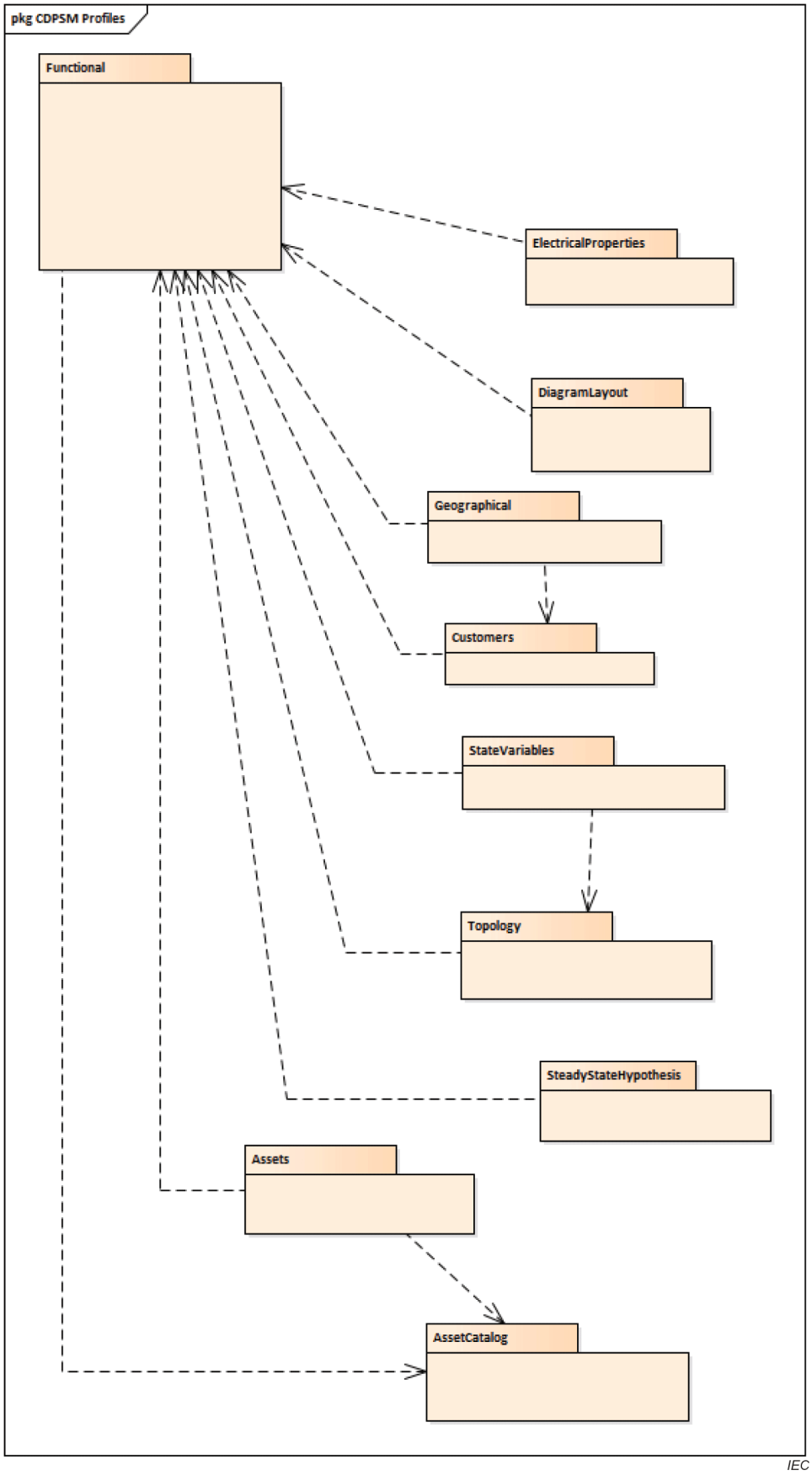


Figure 7 – Package diagram General::CDPSM Profiles

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6.3 Package Functional

6.3.1 General

See Figure 8 for Package diagram Functional and Figure 9 to Figure 28 for the various Class diagram Functional.

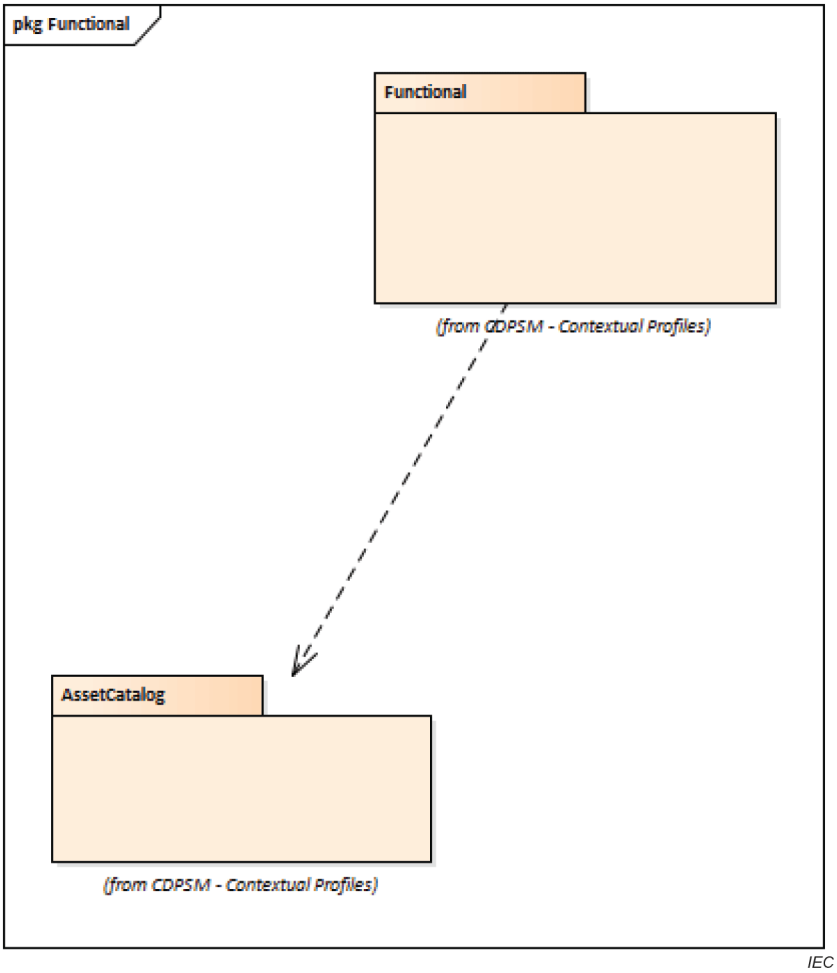


Figure 8 – Package diagram Functional::Functional

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