A Quarter Century of CIM

CIM Users Group

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Brisbane, QLD

A Quarter Century?

- 1992 – The Unified Information provided a data model based on the EPRI OTS to the EPRI CCAPI task force with the understanding it would be developed into an industry standard.
- 1993 - 1996 – the CCAPI task force expanded the data model with the primary goal of enabling the use of “plug compatible” applications to exchange the model, to help protect the utility investment in the applications and data model. The results of this activity is what is commonly referred as CIM 10.

Turned over to IEC

- 1996 – EPRI turned of the work of the CCAPI taskforce in developing the CIM 10 model to IEC Technical Committee 57, working group 13 and 14, were it would advance through the standard process to become an international standard.
- 1996 – 2000 – The model that EPRI provided to IEC developed into two parts.
  - Part 1 was for model of transmission networks to support real-time network analysis (State Estimation).
  - Part 2 was for distribution business processes (work and assets management).
  - The results of this lead to developing the first UML model.

The expansion of the CIM continues

- 2005 First CIM User Group meeting, Carmel, Indiana
- 2006 EPRI started the effort to extend CIM to support transmission planning
- 2007 Initial work for Diagram Layouts
- 2008 UCTE decide to use CIM for model exchange
- 2008 Adopts Sparx Systems Enterprise Architect as the UML modeling tool
- 2009 ENTSO-E established a liaison with IEC TC57 WG13 and WG16
- 2010 EPRI sponsored a project extend the CIM to include dynamics (IEC 61970-457)
- 2011 CIM for Asset Health (i.e. DGA)
- 2013 CIM Harmonization project
- 2015? Work started to include DERs and injector-based devices
- 2016 Project to align GIS information with the CIM
- 2020 Move of Distribution network model into IEC 61870

History of IEC 61970-301

- Part 301: Common Information Model (CIM) Base
- IEC 61970-301:2020 lays down the common information model (CIM), which is an abstract model that represents all the major objects in an electric utility enterprise typically involved in utility operations. 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 network applications developed independently by different vendors, between entire systems running network applications developed independently, or between a system running network applications and other systems concerned with different aspects of power system operations, such as generation or distribution management. SCADA is modeled to the extent necessary to support power system simulation and inter-control centre communication. The CIM facilitates integration by defining a common language (i.e. semantics) based on the CIM to enable these applications or systems to access public data and exchange information independent of how such information is represented internally.

61970-301 ED1 (2003-11)

- First IEC Edition; Published base on the work performed by EPRI and the CCAPI Taskforce

61970-301 ED2 (2009-04) UML iec61970cim11v01

- First edition Annex A which contained the description of the CIM UML model is now a part of the main body of the standard – Clauses 5 and 6.
- A new Annex A was added providing a model of a circuit breaker in the CIM as an example of how the CIM can be used to model network devices.
- Significantly reorganized and expanded Subclause 4.4 Examples to explain: – Containment, equipment hierarchies, connectivity, and naming – Measurements and controls – Role of the new IdentifiedObject class, which replaces the old Naming class.
- The naming hierarchy was changed. New classes GeographicalRegion and SubGeographicalRegion replaced HostControlArea and SubControlArea.
- ModelingAuthority and ModelingAuthoritySet classes were added to represent ownership of models. A ModelingAuthority is a role responsible for a model and is used to break down a large model in manageable pieces with clear ownership.
- A new schedules data model was added to replace the use of the curve model for time series data. New base classes IrregularSchedule and RegularSchedule replaced the class CurveSchedule.
- The measurement value attributes were sub-typed into classes Analog, Discrete and Accumulator.
- The class naming was renamed to IdentifiedObject.
- The Line class was changed to be a specialization of the classes Equipment and EquipmentContainer, so that Line is now a container able to contain all necessary objects to model multiple interconnected ACLineSegments as found in the real world.
- Many editorial corrections, including

61970-301 ED3 (2011-08) UML iec61970cim13v19_iec61968cim10v18

- regulation control models were added with a new RegulatingControl class which provides the capability to model multiple equipments participating in a regulation scheme;
- new “OperationalLimits” package for equipment ratings;
- partial ownership specification added;
- LoadResponseCharacteristic class was enhanced to better model the characteristic response of the load demand due to changes in system conditions such as voltage and frequency;
- new ControlArea package added with load forecast and area interchange specifications;
- EPRI CIM for Planning project proposals to support the exchange of planning models were incorporated;
- branch group “interface” monitoring specification was added;
- composite switch model was changed to better model distribution use cases;
- extensions were added to support powerflow “case input” so that profiles are not required to use time based schedules and detailed connectivity (via new bus-branch model);
- new Equivalents package added to model equivalent networks;
- new Contingency package added to handle contingencies;
- various editorial changes to cleanup UML model;
- non-SI units have been changed to SI units.

61970-301 ED4 (2013-05)

- Major changes from the third edition include the following:
- extensions have been added to support UCTE exchange;
- several classes have been moved from IEC 61970 to the Assets package in IEC 61968;
- the transformer regulation model has been modified and expanded to support phase shifting transformer models needed by ENTSO-E;
- zero and negative sequence impedance terms have been added where missing;
- new StateVariables package has been added to support exchange of network model solutions from power flow, state estimation, etc.;
- additional classes that have been added included:
    - PhaseTapChanger
    - RatioTapChanger
    - ImpedanceVariationCurve
    - RatioVariationCurve
    - TapSchedule
    - SwitchSchedule
    - PhaseVariationCurve
    - EquivalentInjection added to the Equivalents package
    - WindGeneratingUnit and NuclearGeneratingUnit added as subtypes of GeneratingUnit
- classes that were removed included:
    - ompany
    - HeatExchanger
    - MeasurementType
- class removed and replaced with attribute Measurement.measurementType.
    - Datatypes ShortLength and LongLength were removed and replaced with Length.
    - Load, CustomerLoad, and InductionMotorLoad. – Subtytpes of ConformLoad and NonConFormLoad
- various editorial changes to cleanup the UML model.

61970-301 ED5 (2013-12)

- Major changes from the fourth edition include the following.
- transformer models have been modified to be consistent for use by distribution and transmission purposes. Additionally the tap changer model was updated to more clearly reflect the intended usage without relying upon rules for which attributes are appropriate in which situations;
- a more general and clear naming approach was added and several ambiguous attributes related to naming were dropped. The approach allows for users to define new name domains and to give them their own unique description;
- phase component wires models have been enhanced to describe internal phase specific attributes and connections;
- addition of diagram layout models to facilitate the exchange of diagram layout information;
- addition of new data types for Decimal, and clean up of date and time types;
- addition of new Compound data types to the Domain package.

61970-301 ED6 (2016-12)

- This edition includes the following significant technical changes with respect to the previous edition:
  a) new model for grounding including Petersen coils;
  b) models for HVDC;
  c) addition of Static Var Compensation models;
  d) phase shift transformer updates - the section has been added;
  e) short circuit calculations based on IEC 60909;
  f) addition of non-linear shunt compensator;
  g) addition of model for steady state calculation inputs, Steady State Hypothesis;
  h) addition of base frequency model;
  i) corrections of several smaller issues, e.g. issues found at ENTSO-E interoperability tests;
  j) UML clean up;
  k) new model for PowerElectronicUnits and their connection to the AC network added;
  l) new section on relation between TapChanger.ltcFlag and TapChanger.TapChangerControl;
  m) Annex A with custom extensions added

61970-301 ED7 (2020-06) UML ‘IEC61970CIM17v38’, dated ‘2020-01-21’

- Includes the following significant technical changes with respect to the previous edition:
  a) Added Feeder modelling;
  b) Added ICCP configuration modelling;
  c) Correction of issues found in interoperability testing or use of the standard;
  d) Improved documentation;
  d) Updated Annex A with custom extensions;
  e) Added Annex B Examples of PST transformer modelling;

History of IEC 61970-542

- Part 452: CIM static transmission network model profiles
- IEC 61970-452:2021 defines the subset of classes, class attributes, and associations from the CIM necessary to execute state estimation and power flow applications between control centres and/or control centre components, such as power systems applications.

61970-452 ED1 (2013-08)

- First Edition

61970-452 ED2 (2015-04)

- This edition includes the following significant technical changes with respect to the previous edition:
  a) The Steady State Hypothesis (SSH) profile has been added in new Subclause 8.2.
  b) Clause 5 "Overview" has been extended to better describe the relation between different profiles and aligned with the current nomenclature used with profiles, e.g. "data set" and "network part".
  c) The former Clause 6 "Architecture" has been shrunk and merged with Clause 6 "Use cases".
  d) The former Clause 7 "Applying the standard to business problems" has been split and merged with Clause 6 "Use cases" and Clause 7 "Data model with CIMXML examples".
  e) Clause 6 "Use cases" description of the use cases has been extended.
  f) The former Clause 8 "Data model with CIMXML examples" has become section 7 "Data model with CIMXML examples".
  g) The CIMXML document examples in Clause 7 "Data model with CIMXML examples" has been updated to match with IEC 61970-552:2016.
  h) Clause 8 "Profiles" describe the actual profile data. i) Subclause 8.1 "Comments and notes" gives additional information on the use some profile data.

61970-452 ED3 (2017-)

- This edition includes the following significant technical changes with respect to the previous edition: a) The Equipment profile has been split into three separate profiles, CoreEquipment, Operation and ShortCircuit. b) The HVDC model has been replaced with the new model defined in Edition 6 of 61970-301. c) Added attribute IdentifiedObject.mRID
- d) Added class BusNameMarker. e) Added attribute HydroPowerPlant.hydroPlantType. f) Removed attribute HydroGeneratingUnit.energyConversionCapability. g) Added classes related to grounding (PetersenCoil, GroundImpedance, GroundDisconnector, GroundSwitch, and Ground). h) A number of changes have been made to whether specific attributes and associations are required or optional.

61970-452 ED4 (2021-10)

- This edition includes the following significant technical changes with respect to the previous edition:
  a) The classes PowerElectronicsConnection, PowerElectronicsUnit and PowerElectronicsWindUnit are added to the Core Equipment profile.

History of IEC 61970-456

- Part 456: Solved power system state profiles
- The purpose of this document is to rigorously define the subset of classes, class attributes, and roles from the CIM necessary to describe the result of state estimation, power flow and other similar applications that produce a steady-state solution of a power network, under a set of use cases which are included informatively in this standard.

61970-456 ED1 (2015-09)

- First Edition

61970-456 ED1.1 (CONSOLIDATED VERSION 2015-09)

- IEC 61970-456:2013 is based on IEC 61970-301 Edition 4 (2013). Both are based on the 61970 UML version CIM14. The amendment is based on IEC 61970-301 Edition 5 (2013) and the 61970 UML version CIM15. For the Topology profile Amendment 1 includes the following changes with respect to the previous edition:
  a) The classes Name and NameType classes have been added.
  b) The class TopologicalNode has been extended with the role ConnectivityNodeContainer.
  c) The attribute IdentifiedObject.description has been removed. For the StateVariables profile this edition includes the following changes with respect to the previous edition:
  d) The role TopologicalIsland.ToplogicalNodes has been replaced by ToplogicalNode.TopologicalIsland.
  e) The documentation of attributes SvPowerFlow.p and SvPowerFlow.q has been updated.
  f) The attribute SvShuntCompensatorSections.sections has been changed from Integer to Float. d) The attribute SvShuntCompensatorSections.continuousSections is removed.
  g) The attribute SvTapStep.position is changed from Integer to Float.
  h) The attribute SvTapStep.continuousPosition is removed.
  i) The attribute SvVoltage.angle is changed from radians to degrees.
  j) The data types have been elaborated

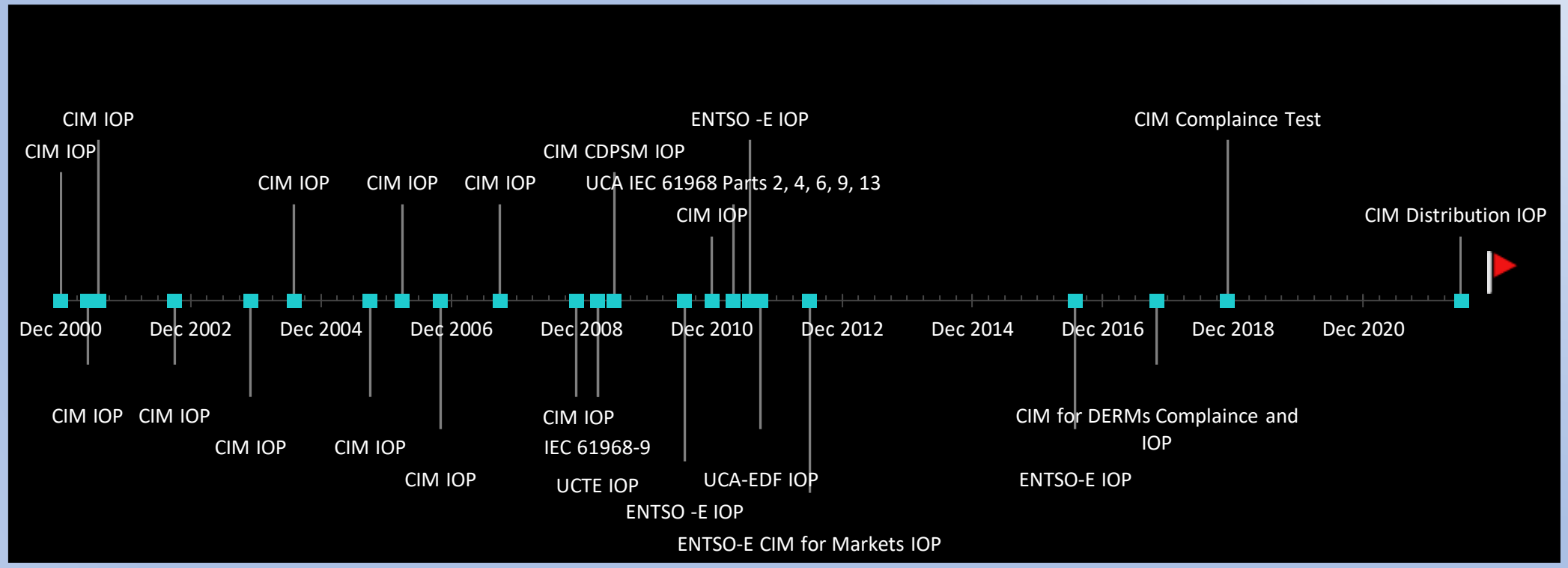
61970-456 ED2 (2018-03)

- This edition includes the following significant technical changes with respect to the previous edition:
  a) The Steady State Hypothesis (SSH) profile has been added in new Subclause 8.2.
  b) Clause 5 "Overview" has been extended to better describe the relation between different profiles and aligned with the current nomenclature used with profiles, e.g. "data set" and "network part".
  c) The former Clause 6 "Architecture" has been shrunk and merged with Clause 6 "Use cases".
  d) The former Clause 7 "Applying the standard to business problems" has been split and merged with Clause 6 "Use cases" and Clause 7 "Data model with CIMXML examples".
  e) Clause 6 "Use cases" description of the use cases has been extended.
  f) The former Clause 8 "Data model with CIMXML examples" has become section 7 "Data model with CIMXML examples".
  g) The CIMXML document examples in Clause 7 "Data model with CIMXML examples" has been updated to match with IEC 61970-552:2016.
  h) Clause 8 "Profiles" describe the actual profile data.
  i) Subclau

61970-456 ED3 (2021-12)

- This edition includes the following significant technical changes with respect to the previous edition:
  a) Updated to support CIM17 (IEC 61970-301:2020+AMD1) and align with IEC 61970-452:ED4.
  b) The classes PowerElectronicsConnection, PowerElectronicsUnit and PowerElectronicsWindUnit are added to the Steady State Hypothesis (SSH) profile to match the changes done for Edition 4 of IEC 61970-452, Core Equipment profile.
  c) Added relevant terms used in this document.
  d) Clarified use of Equipment.inService and Equipment.normallyInService.

CIM IOPS Tests



Into the next Quarter Century

- The CIM continues to gain acceptance and new use cases.