European Network of
Transmission System Operators
for Electricity

entsoe

CGMES Roadmap

2018/12/05 Approved by System Operation Committee

CGMES Roadmap task force

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2. Executive summary

CGMES was developed in ENTSO-E in the last almost 10 years. The development, implementation, standardisation and actual use was driven by various business needs on both operational planning (network codes and guidelines) and long-term planning (TYNDP and regional planning) activities. Various approaches were used and a lot of lessons learned were collected over the years. ENTSO-E considers of at utmost importance to structure all activities related to CGMES. This document, CGMES roadmap, aims at defining a sequence of tasks that have different character such as organisational, development, implementation, maintenance or standardisation.

The CGMES roadmap provides a clear view of what the progress would be in the following 5 years hence it is a valuable document not only for ENTSO-E community but also for suppliers who can better plan their releases and allocate resources to support interoperability testing and necessary developments of CGMES. It also serves IEC working groups to have an overview of CGMES technical specifications or additional standardisation needs that will need to be launched in the coming years.

Many of the activities defined in the roadmap are performed in parallel. The main reasons for this are:

- available resources for maintenance and development of CGMES are limited and discussions on various issues tend to take a lot of organisational time to gather experts, propose solution and reach wider consensus on a CGMES modification. Implementation and testing of the solutions affect the work of multiple business processes hence some activities need to run in parallel to ensure continuity and smooth transition between releases.
- the standardisation process is a long-lasting effort hence even intended releases planned for 3-4 years ahead need initial discussion with standardisation bodies and suppliers. If this is not happening the feasibility to have planned releases in time as required by the business needs is minimal.
- suppliers plan the development of their applications years ahead and allocate necessary resources. Not communicating ahead of time on various proposals for CGMES modifications limits the ability of suppliers to adequately react on TSOs requests for implementing new releases of CGMES or participating in the testing of the draft specifications.

In that sense the roadmap structures CGMES development allowing to meet requirements and to consider feedback from testing and cross checking when implementing in order to minimize interpretations and make data exchanges as robust as possible. For instance, the currently used version is “enhanced” CGMES 2.4.15, described by the technical specification IEC TS 61970-600-1:2017 and IEC TS 61970-600-2:2017 (so called Edition 1 of the IEC TS on CGMES). Capacity allocation and congestion forecast is currently commissioned based on this specification. While doing this, several supporting documents have been created in addition to the IEC TS 61970-600 Ed1. In parallel, substantial parts of IEC TS 61970-600 Ed1 have been incorporated in the IEC standards - the IEC 61970 400 series. This has resulted in the need to create an edition two of IEC TS 61970-600 incorporating the new supporting documents and remove overlap with the IEC 61970 400 series specifications. The roadmap describes among other this work.

It is important to note that the implementation and usage of a new CGMES version is not a subject of the roadmap. The adoption of a version in a business process requires separate decisions and related implementation schedule and resources planning considering smooth transition from one version to another. The CGMES roadmap defines a task for ENTSO-E to clarify the governance model related to the CGMES and establish various processes and communication channels. It is crucial to maintain a good level of backwards compatibility among different CGMES versions which shall be a guiding principle when developing CGMES. However, the community has to be aware that some breaking changes might be necessary in order to better satisfy business needs and adapt to international standards. The rules and the understanding of what backwards compatibility means needs to be further elaborated within ENTSO-E to allow testing of draft specifications for backwards compatibility and being able to

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assess the degree of backwards compatibility (functional level or instance data level). Therefore the roadmap lists a few important organisational tasks which shall be performed in order to ensure a stable framework around all CGMES related activities starting with a good governance model to items ensuring maintenance of issue lists, UML, profiles documentation, conformity test use cases (for FAT and SAT), data and related testing procedures which are all tasks that follow each of CGMES releases is on regular basis.

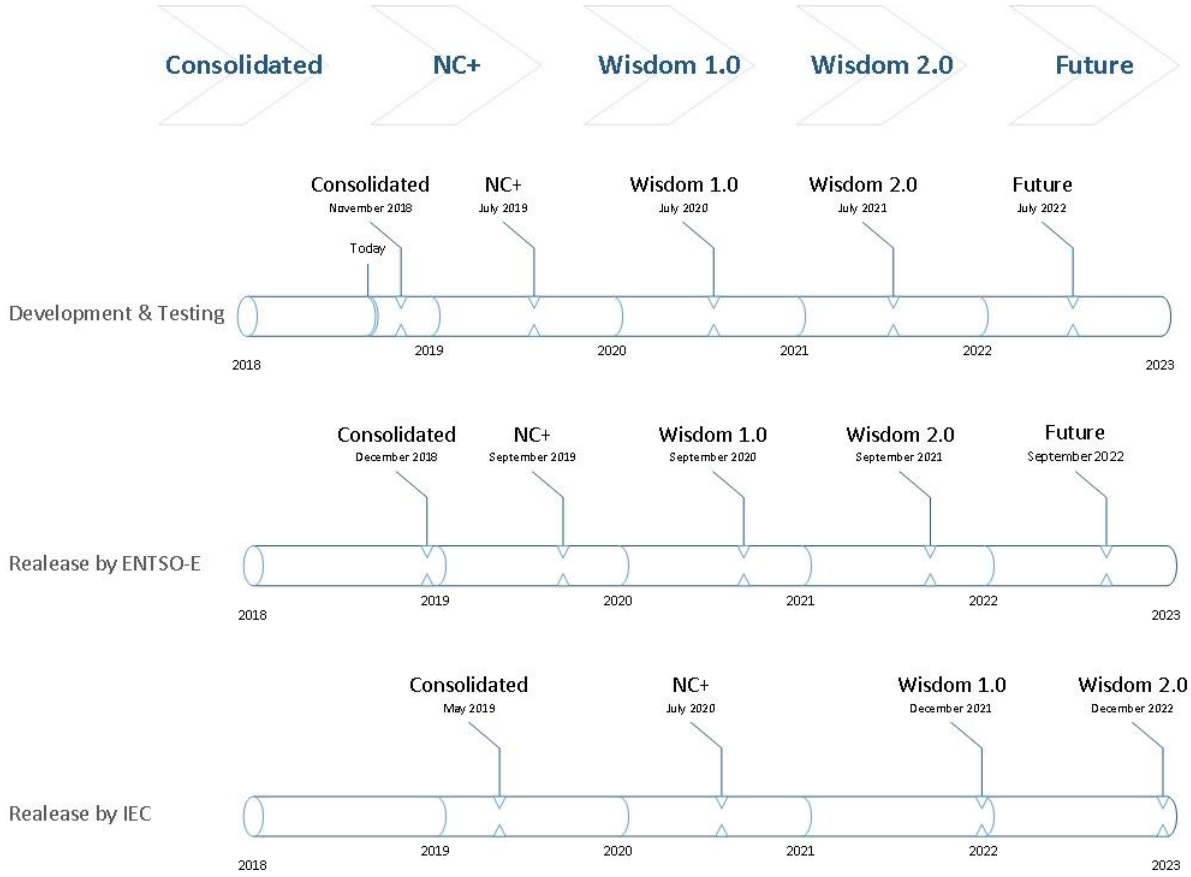

Figure 1 Simplified CGMES roadmap

Consolidated	NC+	Wisdom 1.0	Wisdom 2.0	Future
•Align with and include fixes from IEC •Consolidate currently used guidelines	•Additional profiles •Consolidation with some market documents	•Updates based on NC+ implementation •Harmonization of validation rules •Reference tooling for validation	•Updates based on Wisdom 1.0 implementation •Improved modelling (HVDC, power electronics)	•Updates based on Wisdom 2.0 implementation •Harmonization of TSO and DSO modelling

Figure 2 Releases of the CGMES roadmap

Tracks 1, 2 and 3 are about the content of CGMES and they run in parallel – with highest priority given to Track 1 until completed, then to Track 2 until completed.

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Timelines are split to better focus on stakeholders and kind of deliverables, and they show time dependencies. For instance, when Specification development for Package "Consolidate" gets completed:

- it becomes an ENTSO-E release, ready for approval,
- ready for testing (pre-FAT), after which
- it gets ready for submitting to IEC for standardisation.

The required resources and tasks can be easier planned with these three timelines, because not the same competences are required for the 3 types of activities. For instance, "early adoption" suppliers are interested mainly in Specification development stream and can contribute with timely feedback and implementation. End users (TSOs, RSCs) can count on products that will have the standard implemented incrementally. And ENTSO-E will in the end has its specifications published as IEC Technical Specifications and later on as IEC Standards.

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3. Glossary of terms and abbreviations

CACM	Capacity Allocation and Congestion Management
CENELEC	European Committee for Electrical Standardization
CGM	Common Grid Model: 1. Processes: System operations (operational planning) processes counterpart to system development (TYNDP) 2. Project: ENTSO-E Project (PT CGM) with its 5 work packages 3. Programme: Newly established ENTSO-E program 4. Network model instance irrespective of format (UCTE-DEF or CGMES): Merged multiple IGMs 5. Network model instance in CGMES format: Merged multiple IGMs Given the overloaded usage of the term, confusion is almost guaranteed.
CGMES	Common Grid Model Exchange Specification (Standard rather than Specification was used previously), developed by ENTSO-E 1. ENTSO-E Standard, for CGMES 2.4.15 [2] 2. IEC Technical Specification, for enhanced CGMES 2.4.15 (https://webstore.iec.ch/publication/61124)
CIM	Depending on context, 'CIM' can refer broadly to the standards and processes created by IEC TC57 WGs that share the use of a canonical data model, or it can refer to the canonical data model itself.
DSO	Distribution System Operator
EPRI	Electric Power Research Institute
FAT	Factory Acceptance Test
FAT IOP	Interoperability test in which vendors' implementation is tested using test data. It is part of the conformity assessment scheme.
IEC	International Electrotechnical Commission
IGM	Individual Grid Model, network model of a single Modelling Authority, referencing a boundary model, acting like a pane of glass in a framework (in this framework, the commonly agreed boundaries specify the latticework of the framework, whereas the IGM defines the frame). In ENTSO-E context, at present, the Modelling Authority is Transmission System Operator, to support network codes (in the future, IGM for Distribution System Operators will certainly be needed as well): 1. Network model instance irrespective of format (UCTE-DEF, CGMES, …) 2. Network model instance in CGMES format
IOP	Interoperability (tests) in general. These are tests to support efforts to have interoperability among applications. Interoperability tests are done at various stages: when developing the specification using draft specification and prototype tools; during conformity assessment so called Factory Acceptance Test (FAT) testing using final specification and applications exchanging test data; and during Site Acceptance Test (SAT) testing where the tools are challenged with real datasets.
ISO	International Organization for Standardization

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NC	Network Codes
OCL	Object Constraint Language is a declarative language describing rules applying to Unified Modelling Language (UML) models. OCL is part of the UML standard (governed by Object Management Group (OMG)).
RDFS	Resource Description Framework Schema
RES	Renewable Energy Source
SAT	Site Acceptance Test
SAT IOP	Interoperability test in which applications and their integration in the frame of a business process are tested using real datasets. It is performed when all applications were tested in a FAT IOP.
SDC	System Development Committee (of ENTSO-E)
SDO	Standards Development Organization
SO GL	System Operations Guidelines
SOC	System Operations Committee (of ENTSO-E)
Std IOP	Interoperability tests organised to validate draft standards/technical specifications before they become published and ensure that the vendors can develop support before the 'ultimate' standard publishing. Always refers to a specific version number, which normally gets increased after the issues found in tests get fixed and incorporated into the draft standard. It is a pre-FAT testing that also validates that test data to be applied in the conformity process.
TSO	Transmission System Operator
TYNDP	Ten Year Network Development Plan, ENTSO-E SDC process running based on CGMES since 2016 (version 2.4.15 of August 2014)
UCTE	One of the predecessors of ENTSO-E
UCTE-DEF	UCTE data exchange format for load flow and three-phase short circuit studies[1]. ASCII - text based format supporting exchange of bus-branch network models, in use today for study network model exchanges, derived from the IEEE data exchange format, developed in the 1960s. It requires many additional data exchanges and legacy coding schemes. CGMES is meant to fulfil all these data exchange needs in a unified way.
UML	Unified Modelling Language. UML is a general-purpose, developmental, modelling language in the field of software engineering, governed by Object Management Group (OMG) and from 2005 published as ISO standard.

[1] http://cimug.ucaiug.org/Groups/Model%20Exchange/UCTE-format.pdf

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4. Methodology of the CGMES Roadmap

4.1. Request

In its meeting on 18th April 2018, Digital committee requested the ENTSO-E secretariat to launch a call for experts who will develop the CGMES roadmap.

The CGMES roadmap is needed to agree on a work program and on a budget for the data exchange standardization to support the implementation of the network codes and the TYNDP. In addition, the IEC Technical Specifications on CGMES need an edition 2 published before they expire in 2019.

4.2. Scope

The project includes the following tasks:

- Establishment of the team: a call for volunteers (ENTSO-E, TSOs and RSCs) to participate to the drafting of the CGMES roadmap. 15 volunteers have actively participated to the project.
- Analysis of the present situation with CGMES development and identification of tasks to be described in the roadmap.
- Organising the review and approval process of the roadmap.

The execution of the roadmap is out of scope for this project.

4.3. Objective

The objective is to elaborate a CGMES roadmap for ENTSO-E. The CGMES roadmap will be proposed to the Digital committee. The CGMES roadmap will serve as a basis for the work of the ENTSO-E CIM Expert Group (EG) that is to be created.

4.4. Planning

The project lasted 2 months with regular calls and a physical meeting. The planning was the following:

- Call for volunteers: 19th April to 3rd May 2018
- First draft for comment: 22nd May 2018 (intermediate presentation to Dc)
- Final draft of the CGMES roadmap: 13th July 2018
- Review from different ENTSO-E entities: by 2nd September 2018
- Submission to Digital committee: 3rd September 2018

4.5. Team

Here are the names of the volunteers who participated in the drafting of the CGMES roadmap:

Adriano Gubernali, Alvaro Marciel Rodriguez, Chavdar Ivanov, Christophe Lallemand, Dario Consolato Frazzetta, Erdet Këlliçi, Fabio Oliveira, Kees Sparreboom, Kostas Passadis, Kristjan Vilgo, Lars-Ola Gottfried Österlund, Marco Chiaramello, Marcos Olmos, Miguel Escribano, Silvio Ferreira, Svein Olsen, Tatjana Kostic and Olivier Aine.

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5. CGMES history and lessons learned

5.1. The beginning of the CGMES

In the period of 2002-2006 the working groups of the UCTE identified a need to have increased cooperation between TSOs in the area of grid modelling as power system changes due to RES and other factors as well as requests for interconnection studies were rapidly increasing. Following these discussions, the task to define a complex data exchange standard which covers operational planning and long-term planning allowing for all kinds of studies (load flow, short circuit or dynamics) was set as a priority among many measures were taken in grid modelling domain.

In 2007 UCTE established an ad-hoc group to analyse data exchange requirements and define a standard that covers them. First proposals included significant enhancement of the UCTE data exchange format or adoption of one of the existing and widely used proprietary formats. However, TSOs rejected these as such proposals were not meeting the requirement to base future data exchange standard on an international standard.

In 2008 UCTE agreed to develop the new data exchange standard based on the IEC Common Information Model (CIM) which is an abstract information model that provides data understanding through the identification of the relationships and associations of the data within an electrical utility enterprise. This enhanced data understanding supports the exchange of data models and messages and increases the ability to integrate applications both within the enterprise and with trading partners. These trends go beyond exchange or updates of network models to the exchange of specific dynamic data within transactional messages in a real-time environment. The CIM companion standards provide various application programming interface services and component interface specifications that, when used in conjunction with the CIM models, provide a framework for the exchange of static models, transactional messages and full enterprise integration. Following this agreement UCTE established contacts with CIM user group [5], IEC and EPRI.

In 2009, ENTSO-E, a successor of UCTE and ETSO activities on applying CIM in data exchanges, reconfirmed all previous agreements and continued to be involved in CIM development and actively cooperated with international organizations. Interactions were done mainly via:

- liaison with WG13 (Energy management system application program interface), which is a working group of IEC Technical Committee 57 (Power systems management and associated information exchange),
- a liaison with IEC TC57/WG16 (Deregulated energy market communications) in order to contribute in extending of the CIM to support the models and the objects required for energy market information exchanges,
- participation of the EPRI project “CIM for Dynamics” that proposed to IEC necessary CIM extensions for exchange of dynamic models.

The development of the CIM standards over the last two decades was based on strong business cases. Multiple industry driven projects were launched to define use cases and propose the right solution based on CIM or necessary CIM extensions. A necessary foundational element in satisfying interoperability requirements of the future grid is a common language for data – a common semantic model. This is the IEC TC57 CIM, a key standard in the USA SGIP (Smart Grid Interoperability Panel) catalogue of approved standards for Smart Grids as well as in the CEN/CENELEC M/490 SGAM (Smart Grid Architecture Models) framework standard for Europe. The CIM helps organize and structure shared data through the use of a very complete model of the entire power system grid (transmission and distribution) and all aspects of power system management, planning and operations to provide common semantics for information exchange.

5.2. First development, implementation and standardisation

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The following figure illustrates the complex process starting with the task to identify business needs and collect requirements until the stage in which the applications/tools are used by utilities, TSOs, ISOs or other entities. Due to the nature of the framework provided by the IEC to develop and approve CIM international standards, the process is relatively slow, which in turn creates a challenge related to need for timely implementation of the CIM solutions. Therefore, utilities and policy makers are working to ensure that they support initiatives aimed at expediting the standardisation process by proposing to Standards Development Organization (SDOs) well-tested and vetted CIM-based solutions. This will eventually speed up the adoption of CIM standards, their implementation and usage which will increase efficiency in the business processes, thus maximising the added value for network operators and the industry in general.

Normally the efforts to test conformity and perform other important steps are coordinated by a body (association, users' forum, project, reliability organization) in cases where there are a large number of entities that need to exchange data in compliance with legislation or to solve a particular business need. An example for such setup is the efforts that ENTSO-E is performing in Europe.

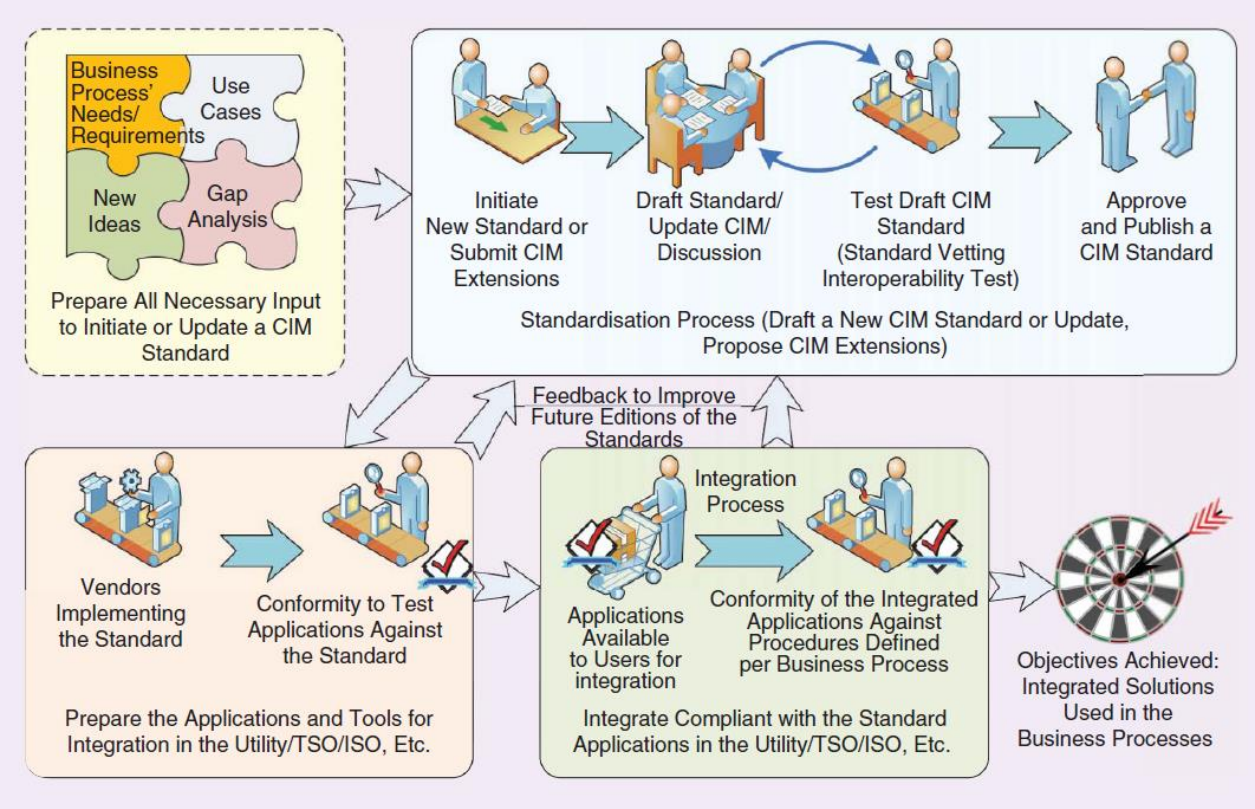

Figure 3 Illustration of the standardization process.

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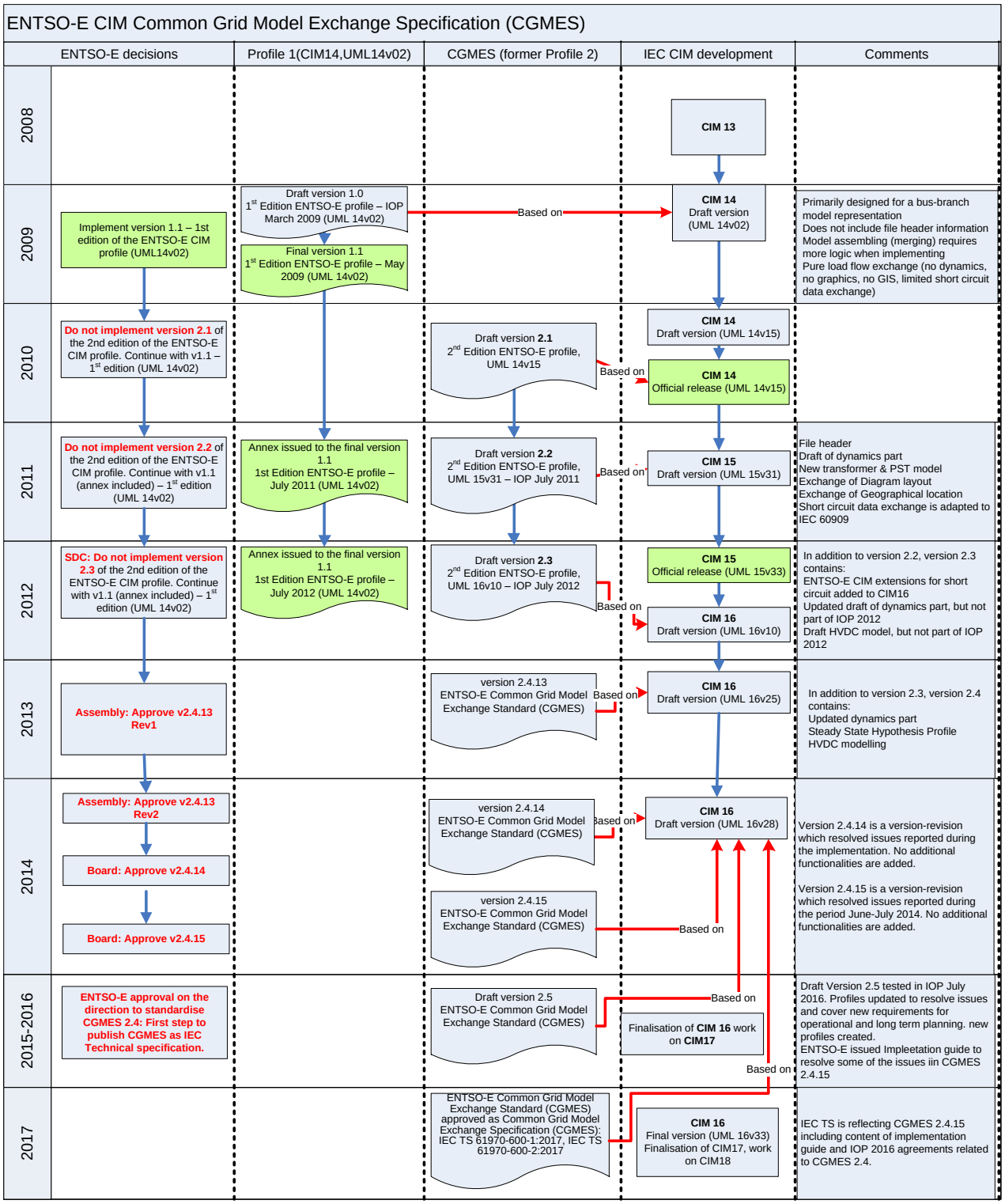

Figure 4 During the period 2008-2016 ENTSO-E actively developed CGMES

Since the main approval of CGMES 2.4 in 2013 (see ENTSO-E Assembly decision TOP10, approval in Dec 2013 Assembly voting procedure), ENTSO-E SDC and SOC continued working on covering the further needs of operational planning processes to support network codes (SO GL [OS + OPS], CACM,

FCA)[2]. Requirements were analysed, and development was planned along with the network codes development and refinement, in development stream (TF CGM, then PG CGM, see SOC session file [1]) for the targeted CGMES versions as approved by SOC and SDC. The following figures recall the comparison between CGMES 2.4 and UCTE DEF in terms of coverage of requirements for operational planning. CGM WP2 made the following assessment: the targeted CGMES version (tested in IOP 2016, as reported in [6]) would cover 97 % of these requirements while the coverage by CGMES 2.4 is 75%.

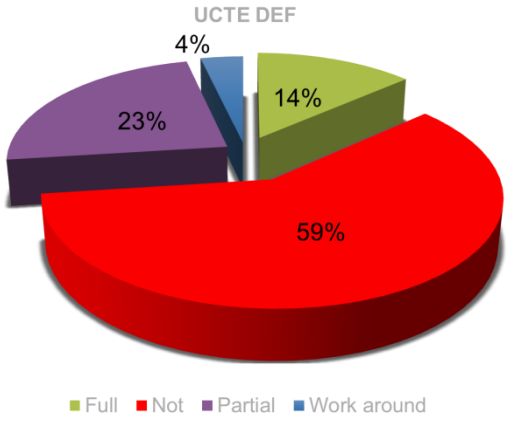

Figure 5 UCTE DEF coverage of requirements for operational planning

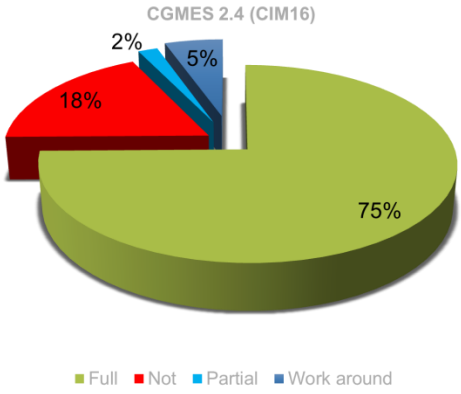

Figure 6 CGMES 2.4 coverage of requirements for operational planning

Draft version of CGMES targeted by PT CGM after CGMES was frozen in 2014

2 https://docstore.entsoe.eu/Documents/CIM_documents/Grid_Model_CIM/140113_CGMES_information_webinar%20Consolidated.pdf

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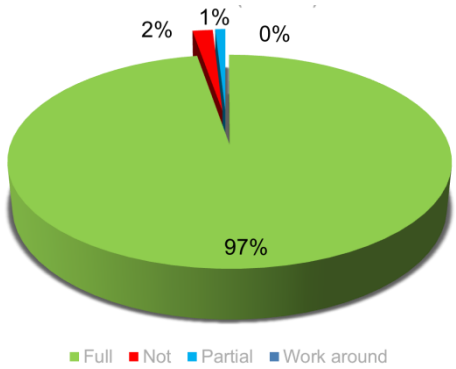

Figure 7 planned CGMES version (after 2016 IOP) coverage of requirements for operational planning

Next to efforts to analyse requirements and to find the best way to cover them in CGMES, the importance of interoperability testing to ensure vendor compliance to CIM standards was found crucial. There are at least two types of efforts directly linked to interoperability testing:

- Efforts to validate a CIM standard as a part of the standard's development process;
- Efforts to validate the conformity of available software solutions with an approved standard.

The interoperability testing to validate the correctness of the CIM standards started in 2000 with the first interoperability test sponsored by EPRI and held in Las Vegas, USA. These tests were driven by NERC requirements in North America and were focused on the CIM standards designed to exchange common power system network models between operational systems (SCADA/EMS solutions). Later on, activities expanded to cover validation of the CIM standards related to planning and the energy market as well as for message payloads to support system integration.

Currently in Europe, ENTSO-E plays a leading role in organising CIM interoperability tests related to both grid model and market exchanges. Since 2009, ENTSO-E has organised six large-scale IOP tests for grid models exchange. In 2012, ENTSO-E organised the first IOP on CIM for energy market and began a series of IOPs related to the CIM for European market style.

In 2014, ENTSO-E launched a conformity assessment framework related to the CGMES which is an ENTSO-E standard based on CIM and used by the ENTSO-E TSOs for operational and system development exchanges. Using the conformity assessment framework, ENTSO-E provides services to assess different tools developed by vendors. This is an example of an effort which targets validation of the available application against specification of a standard. The CGMES conformity relies on processes specified in the ISO standards on conformity assessment. Due to the complexity of an ISO based certification process ENTSO-E decided to design the CGMES conformity more as a service towards suppliers and ENTSO-E members rather than a full-scale certification process. Only first party assessment and second party assessment processes are applied. According to ISO the first party assessment activity is a conformity assessment activity that is performed by the organization (supplier) that provides the object (IT application). In such case, a Supplier would declare that his product(s) is conforming to the specified requirements by issuing a "Declaration of Conformity". The second-party conformity assessment activity is performed by an organization (user) that has a user interest in the object. In the setup applied by ENTSO-E the first parties are all vendors that would like to conform to CGMES. ENTSO-E performs the role of a second party and issues an "Attestation of Conformity". This process could be applied for IEC CIM standards as well and it could be extended, if necessary, to fully apply the ISO standards for certification where the assessment is performed by an additional third party. ENTSO-E has already benefited from this effort by ensuring TSOs receive better tested applications for integration into the business processes in the TSO environment.

Conformity assessment also provides a solid base of test data for future development of the CIM standards. Most importantly the conformity process and the implementation of the CGMES enables

roll-out of the system development studies and the implementation of the European network codes. The following figure illustrates the CGMES conformity assessment process. It is important to note that the current design of the CGMES conformity assessment scheme allows assessment of the applications only on certain CGMES functionalities that are supported by the assessed application. Hence, declarations of conformity and attestations of conformity cannot be used as a confirmation that an application is fully covering requirements on a specific business process. Continuous development of conformity process will allow assessment of the applications used by the European TSOs against the requirements of the business processes such as day-ahead congestion forecast, other operational planning exchanges defined in the European Network codes as well as long term planning data exchanges.

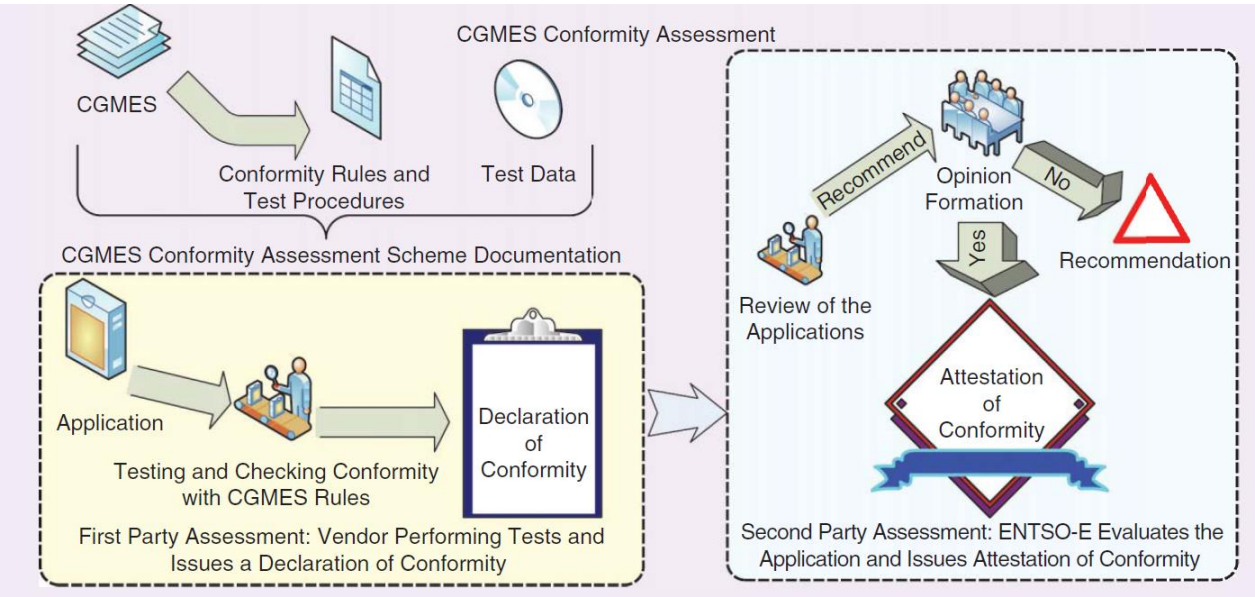

Figure 8 Illustration of CGMES conformity assessment

5.3. Lessons learned

As expected there are large amount of lessons learned and some of these were driving the processes related to development and implementation of CGMES. This section provides a brief summary of the lessons learned:

- The TSO community cased a learning curve in gaining some CIM knowledge. Needed resources were underestimated. Continuous training and knowledge sharing activities are necessary in order to keep experts close to each other on working level.
- The way how the profiles are described should be reviewed. During the years different approaches were taken to improve on this and now the maturity is higher however additional work is expected to translate non-machine-readable rules into code in order to have a single place to maintain the rules and implement them by all parties in the exchange. This will further improve the clarity of CGMES.
- In the past, vendors were questioned if CIM export/import functions were tested ahead of release of applications. Some vendors were doing better than other. This significantly delayed implementations as a lot of testing had to be done at TSO level and a lot of elementary bugs were found. Following this experience CGMES conformity was developed. Now the task is to further enhance this based on the experience and create necessary structures in order to keep the test data up to date and matching test use cases part of the conformity scheme.

- IEC has its own roadmap for CIM development and maintenance cycles for the standards. ENTSO-E as part of this process developed processes to make sure that IEC standards reflect on Europe's needs. However, in order to be able to realise this task, ENTSO-E needs resources to maintain CGMES specification and be able to monitor all changes in IEC standards as well as suggest modifications. This CGMES roadmap and enhancements of ENTSO-E processes are some of the tools ENTSO-E will be using to get better on this topic.
- The entire process from analysing of the requirements to the practical use of the data exchange standards/specifications is very long, while the business needs are in most of the cases requiring fast implementation and use. Appropriate governance model on CGMES in ENTSO-E is necessary to make sure priorities are well set. However, on working level it is necessary to develop maintenance approach for CGMES so that certain modifications can be approved and standardised quickly, enabling fast track towards the use of a new version. Vendors shall be encouraged to supply solutions that are able to migrate to newer version quicker. TSOs shall be encouraged to do the integration work quicker.
- Many R&D projects were launched in the last years, but only a few were required to look at the data exchange in terms of CIM development. Having the ENTSO-E CGMES Roadmap, it is believed it will be valuable instrument for future R&D efforts in order to see the directions and find the right cooperation to make sure projects follow up and help the standardisation efforts.
- Interoperability when using real data sets is crucial. Due to confidentiality reasons it was not always possible to exchange real data sets with vendors or do testing ahead of the standardisation. Some further efforts are needed in order to have different sets of data that can be used in addition to the test data available in the conformity process. This will make the tools more robust and minimise the time needed for testing later in the implementation processes by TSOs.
- Uniform quality rules for both exchanges for planning and operations are crucial for CGM exchanges to guarantee interoperability and a common understanding of the data being exchanged.
- In order to address ambiguities in the specification multiple implementation rules have been added to the required implementations. Several TSOs have objected to these last-minute changes due to the associated costs for change requests towards their vendors.
- Conformity attestation was granted on erroneous test data sets. The conformity has not been reassessed after correction which means that some vendors had outdated implementations.
- Test data sets are not able to capture all modelling styles found in the real data sets. As confidentially issues generally prevent sharing of TSO models with the tool vendors, TSO experts have to take care of problem identification, "anonymisation" and issue handling towards the vendors. Since the TSO experts CIM knowledge can be limited and the release cycles of the software tools may be few times per year correction of CGMES issues takes very long time.
- CIM relies on globally unique IDs for all objects which are persistent over time. Experience shows that operational and planning models are typically using different IDs for the same equipment. Between different versions of planning models, it is even common to see new IDs appearing in every model. The lack of persistency prevents relating new information to the model such as single line diagrams, geographical data or contingency lists.
- In 2017 the CGMES specification was replaced by the IEC 61970-600 specification. Due to the costs associated not all TSO experts have access to the IEC standards and specifications. The old CGMES 2.4.15 specification is still widely used. There is a need to make a common full documentation package freely available for all parties.

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5.4. Status of the CGMES documentation

The version of the CGMES standard used in this process is an enhanced 2.4.15 and is based on CIM version 16.

Enhanced CGMES 2.4.15 is described by the following important documents, as of this writing available on the ENTSO-E CGMES portal (as documents or references):

- IEC TS 61970-600-1:2017 and IEC TS 61970-600-2:2017
- UML document in XMI format describing the
    - ENTSO-E CGMES extensions
    - CGMES profiles
- The set of profiles described in the RDFS format.
- OCL rules describing additional constraints on the UML
- Important CIM 16 documents that are the basis for enhanced CGMES 2.4.15 are
    - IEC 61970-301 Ed6
    - IEC 61970-452 Ed3
    - IEC 61970-456 Ed2
    - IEC 61970-453 Ed2
    - IEC 61970-552 Ed2
- The complete set of standard documentation for CGMES can be purchases at IEC as IEC 61970-CGMES:2018 PAC.
- Canonical UML version iec61970cim16v28 available as an Enterprise Architect or XMI file.

While work in CGM program progressed, issues have been found. As the above listed documents have been frozen, updating them with corrections is not possible. Instead, solutions have been described in the following CGM related documents that also relate to the CGMES – these are later on referred to as CGMES nonstandard documents:

- “Implementation guide for CGM network modelling and CGMES exchanges.docx” version 0.16 of November 2017.
- “EMF requirements specification v2_final.docx”
- “Quality of CGMES Datasets and Calculations (QoCDC) 2nd edition”
- “QoCDC 3rd edition” (not yet implemented)
- “QoCDCv3-changes.docx” that describe changes to QoCDC 3rd edition (not yet implemented)
- “HVDC interoperability requirements specification.docx”
- “Addendum 1 to Requirements specification PEVF.docx”

As a consequence, implementers of CGMES 2.4.15 need to find, read and understand the above documents. This resulted in requests to consolidate the CGMES documentation and make it easily available.

The Quality Portals (QAS) that validate and check IGM and CGM data are currently based on “QoCDC 2nd edition”. The QoCDC documents describe errors in IGM/CGM data in two ways:

- By referring to the OCL rules describing constraints on the CGMES profiles (refer to document list above).
- By English text in the QoCDC documents.

The OCL rules can be machine translated into code that do data validation (e.g. in QAS) but the English text rules cannot. This resulted in requests that the English text rules shall be expressed so that they can be translated into code that does validation. As OCL is already used the natural solution is to extend them to also include the English text rules.

During the work to extend the CGMES profiles with additional information models (e.g. availability planning, remedial action schemes, system integrity protection, etc.) to fully support the automated power flow studies, an issues list has been used to track issues. Some of the issues are also relevant for CGMES 2.4.15.

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6. Overview of the business needs for CGMES related data exchange

6.1. Network Codes

The EU Network Codes' status and overview with the links to the different codes are available on https://electricity.network-codes.eu/network_codes/.

The code outlines the requirement to develop different methodologies that address how the network code can be fulfilled by the relevant organisations. The following EU Network Code methodologies are providing requirements to CGMES:

- Common Grid Model Methodology (CGMM) v3[3]– 2018-02-12
    - IGM/CGM creation
    - Boundary management
- Generation and Load Data Provision Methodology (GLDPM) v2 [4]– 2017-02-14
- Coordinated Operational Security Analysis Methodology[5] (CSAM) 2018-02-26 – Consultation 2018-04-06
    - Supporting document to the CSA (SO GL Art 75) and RAOC (SO GL Art 84) methodologies
- Regional Operational Security Coordination (SO GL Art 76)
- Outage Coordination Asset Assessment Methodology (SO GL Art 84) 2018-02-28 – Consultation 2018-04-06
- Capacity Calculation Region Methodology (CCM) (one for each CCR)
    - Nordic Capacity Calculation Region Methodology (Nordic CCM) – 2017-09-11
        - Supporting: Stakeholder consultation document and Impact Assessment for the Capacity Calculation Methodology Proposal for the Nordic CCR
- Scenarios alignment (PEVF, CGMA)

[3] Two previous versions exist: Common Grid Model Methodology (CGMM) v1 – 2016-05-27 and Common Grid Model Methodology (CGMM) v2 – 2017-06-09

[4] A previous version exists: Generation and Load Data Provision Methodology (GLDPM) v1 – 2016-05-13

[5] SOGL Art 75

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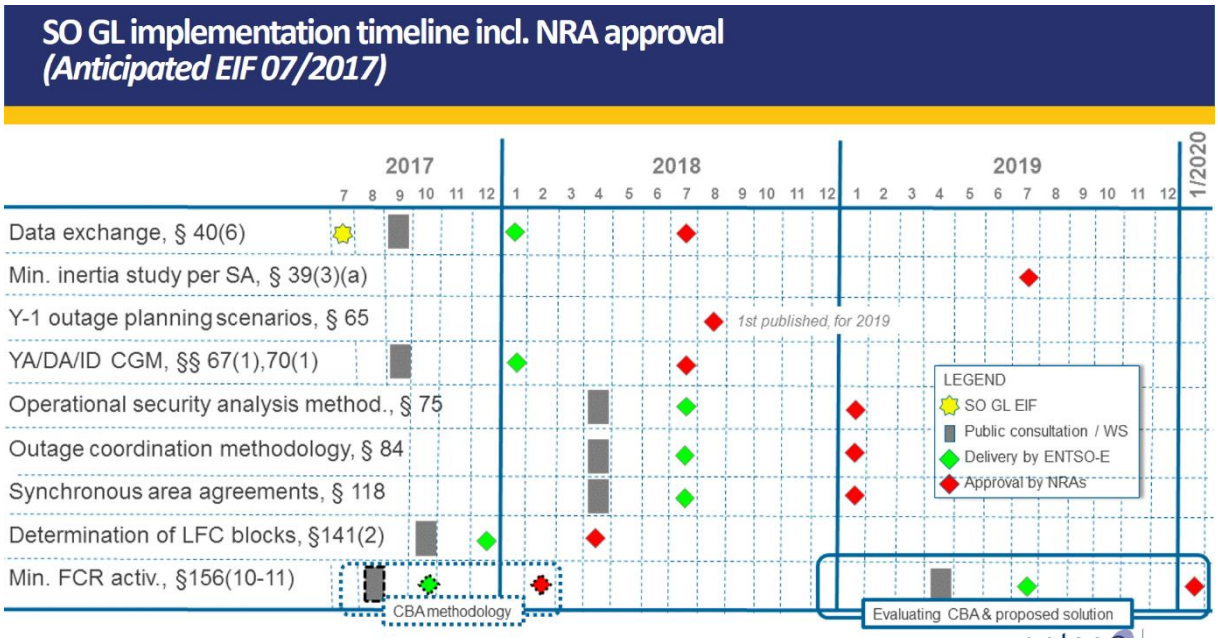

Figure 9 Illustrative timeline of SOGL implementation timeline

6.2. TYNDP

Long term network planning (TYNDP)[6] is a major business processes based on network models exchanged in ENTSO-E-defined profiles derived from CIM. From 2009 to 2017 this process used ENTSO-E profile 1 based on CIM14. After that test, implementation and use of the CGMES was launched. The data collection for TYNDP 2018 was based on CGMES.

6.3. Integration with market exchange

Currently grid data exchanges and market exchanges are realised in different ways which requires substantial effort to interface between different exchanges. Necessary modelling work needs to be planned to perform analyses and propose solutions which will increase the integration level between grid data and market data exchanges.

6.4. TSO-DSO data exchanges

The CGMES IOP in 2016 already considered the requests by TSOs to have development of CGMES in the direction to support TSO-DSO data exchanges. However, the work is not yet completed and the interface with market exchange needs additional efforts to ensure interoperable and integrated data exchange

[6] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:115:0039:0075:en:PDF

7. CGMES Roadmap

The proposed CGMES Roadmap is shown in the figure below:

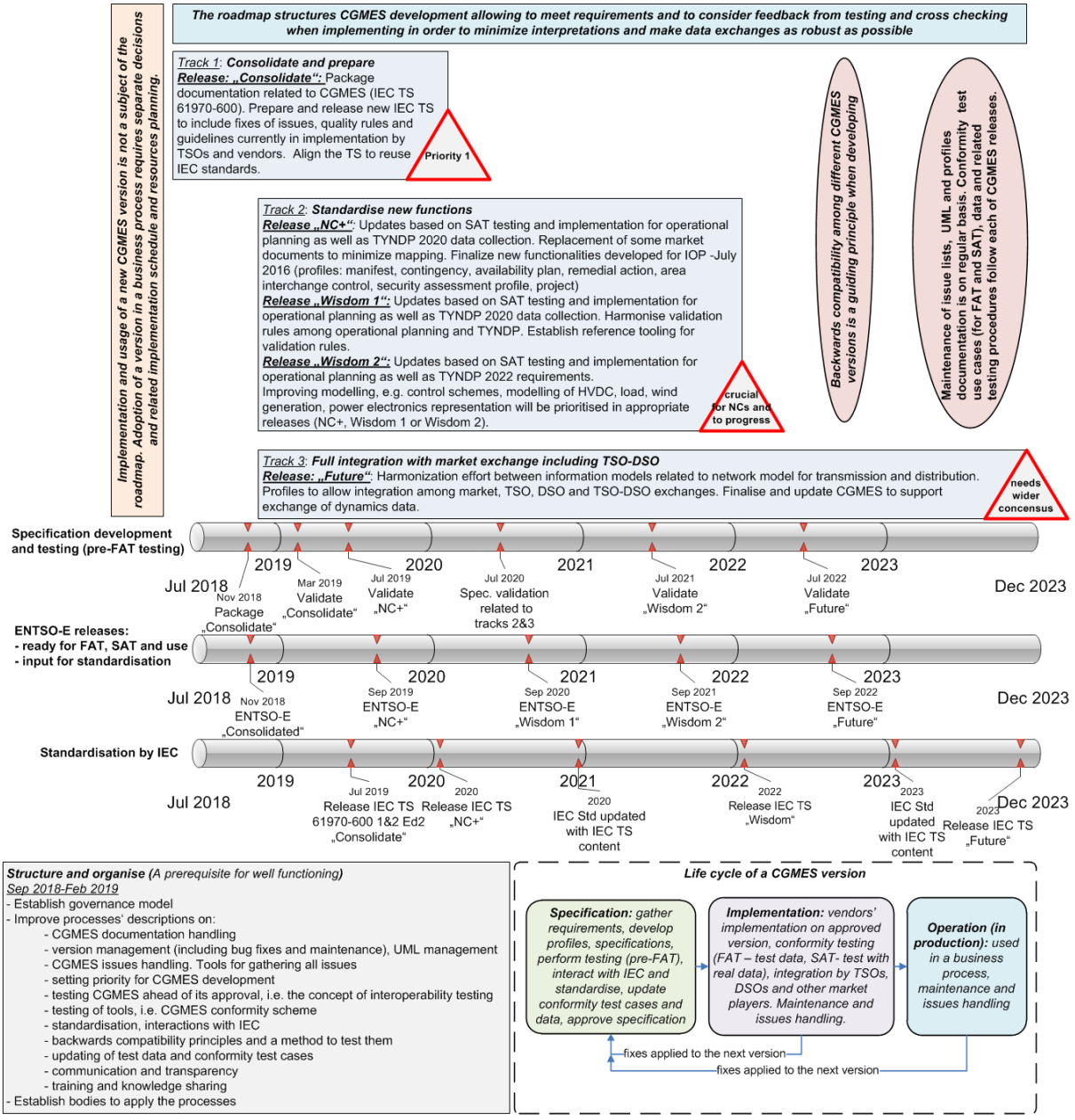

Figure 10 Detailed CGMES Roadmap

The time axes give the view on milestones per stakeholder. For instance, Specification development and testing is the first set of activities that need to be completed. From that moment on, the specifications are ready for ENTSO-E stakeholders. Once the approval procedure takes place, the formal standardisation procedure with IEC is launched. Implementations however do not need to wait until the IEC publishes related standards and can also proceed during Specification development and testing – with reasonable expectation that ENTSO-E approval process will be successful. This kind of separation is needed to also distinguish different resources needed in the three different stages of preparation if the specification, i.e. specification development, ENTSO-E release and finally standardisation by IEC.

The three tracks are mostly running in parallel in order to ensure timely delivery of the planned releases. However, track 1 related tasks have the highest priority as this track is setting the ground for other tracks and related releases. As illustrated in the chart the publication of the different releases is sequential.

7.1. Methodology to organize the tasks

CGMES Roadmap incorporates 3 tracks for main deliverables around CGMES. The tasks to reach the planned milestones have therefore been organized in 3 parallel tracks:

1. Track 1: Consolidate and prepare:
    - Current implementation of the CGMES and related guidelines: Package documentation related to CGMES (IEC TS 61970-600). Prepare and release new IEC TS to include fixes of issues, quality rules and guidelines currently in implementation by TSOs and vendors. Align the TS to reuse IEC standards.
    - Release: Consolidation
2. Track 2: Standardise new functions to support NC:
    - Release „NC+“: Updates based on SAT testing and implementation for operational planning as well as TYNDP 2020 data collection. Consolidation with some market documents to minimize mapping. Finalize new functionalities developed for IOP 2016 (profiles: manifest, contingency, availability plan, remedial action, area interchange control, security assessment profile, project).
    - Release „Wisdom 1“: Updates based on SAT testing and implementation for operational planning as well as TYNDP 2020 data collection. Harmonise validation rules among operational planning and TYNDP. Establish reference tooling for validation rules.
    - Release „Wisdom 2“: Updates based on SAT testing and implementation for operational planning as well as TYNDP 2022 requirements.
    - Improving modelling, e.g. control schemes, modelling of HVDC, load, wind generation, power electronics representation will be prioritised in appropriate releases (NC+, Wisdom 1 or Wisdom 2).
    - Releases: NC+, Wisdom 1 and Wisdom 2.
3. Track 3: Full integration:
    - Not specifically required from the NC but necessary for a coherent CGMES. Harmonization effort between information models related to network model for transmission and distribution. Profiles to allow integration among market, TSO, DSO and TSO-DSO exchanges. Finalise and update CGMES to support exchange of dynamics data.
    - Release: Future

Most of the tasks are performed in parallel to ensure continuity of the various processes. Although the roadmap defined five releases for the purpose to structure the development, it is highly probable to happen that additional releases are published to satisfy business needs and/or correct issues found in different stages of implementation or usage. It is expected that these are revisions or minor versions of the CGMES.

7.2. Lifecycle of a CGMES release

Lifecycle of a CGMES release can be divided in three main streams as follows:

- Specification stream, including activities related to:
    - gathering of requirements and their analysis,

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- discussions and decisions on the way to further develop CGMES (suggesting ENTSO-E extensions or direct modifications of IEC standards specifications),
- performing testing with vendors ahead of freezing the specification (i.e. Std IOP). The objective of this IOP is to verify the specification by using prototype tools and test data. The IOP is also validating the test data and verifying or modifying test use cases. The outcome of the IOP is: improved specification, test data and test use cases
- interactions with IEC to ensure standardisation,
- updating of related conformity test cases and test data

The specification stream finishes with the approval (first by ENTSO-E and later by IEC) of a version of CGMES. The approval by ENTSO-E is a prerequisite for launching the implementation stream and standardisation process with IEC.

- Implementation stream. This stream includes activities related to:
  - vendors' implementation of a given approved version of the specification,
  - conformity testing (FAT). The process of ENTSO-E conformity assessment scheme where applications are tested to ensure that vendors implementation is according to the specification. The tests are done following predefined test use cases and using test data. Interoperability tests are so called FAT IOP, they are performed by vendors and reviewed by ENTSO-E and applications receive attestation of conformity from ENTSO-E,
  - tests with real datasets (SAT). These tests are performed after the integration work by TSOs to integrate tested applications and prepare for putting these in production. Interoperability tests organised at this stage are so called SAT IOP. These tests verify primarily the correctness of applications in the frame of a concrete business process (e.g. operational planning or TYNDP). Real datasets are used and modelling practices as well as implementation guides valid for the business process are checked,
  - maintenance of CGMES including update of the specification as well as UML, RDFS, etc to implement resolutions of issues or perform bug fixes.

  The implementation stream finishes as soon as the operational stream starts.
- Operational (in production) stream. This stream includes activities related to issues discovered during actual use of the specification in real data exchange. Change management process is applied in order to resolve the issues, have their proper implementation and testing (FAT, SAT) as well as necessary training and communication. The CGMES roadmap cannot define these as they would appear during the use of the specification.

Bugs found during the implementation and operational streams are filed back into the specification stream, to be dealt with / resolved for the update of existing or scheduled for the next CGMES release.

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8. Tasks

8.1. Organizational tasks

8.1.1. CGMES development processes and versioning

Description

Over the years CGMES activities expanded due to increased requirements and usage of the specification. ENTSO-E established new internal structure and priorities, hence some processes related to CGMES shall be defined to have stable ground for future development and implementation. The following processes need adequate description in the new environment:

- process for version management (including bug fixes), UML management, UML/CGMES documentation maintenance work
- process for proper CGMES documentation handling, clarity on where the information is available
- process for CGMES issues handling. Issues are discovered by all parties involved in the exchanges. Tools for gathering all issues are needed and the process to resolve the issues shall be clarified.
- process for setting priority for CGMES development
- process to ensure consideration of both type of exchanges – operational planning and long-term planning and have common understanding of the needs
- process for testing CGMES ahead of its approval, i.e. the concept of interoperability testing
- process for testing tools, i.e. refer to CGMES conformity process
- process for standardisation, i.e. explain interactions with IEC
- backwards compatibility principles shall be well defined, and a method shall be found to test backwards compatibility at both stages specification and tools which implemented the specification
- process for updating of test data and conformity test cases
- process of communication and transparency, i.e. what is available on ENTSO-E web site, CIMug site, newsletters, exchange among WGs and committees, etc.
- process on training and knowledge sharing covering topics from training on the processes and roadmap to core CIM/CGMES topics.

In addition, a governance model shall be designed and approved to enable the execution of the CGMES roadmap and proper functioning of the CGMES related processes.

Related requirements

The need to have well established structure and clarity around CGMES work and the ability to better plan and estimate resources needed for this work.

Implementation

This task will be performed by CIM expert group as their 1st priority. The drafting of the mentioned processes shall consider established practices related to CGMES and shall refer to existing agreements as much as possible. Building on this it is estimated that all processes can be described using 10-15 man days of effort. The process description shall include the following elements: description and workflow, involved bodies, resources needed to perform the process on regular basis.

Release date

Some of the basic processes shall be finalised by Q3 2018 other by Q1 2019.

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8.1.2. Training / expertise

Description

The development, implementation and usage of CIM and related CGMES require constant learning and knowledge sharing among TSOs. Without this the maintenance of the CGMES, issues resolutions and the implementation will be mostly dependable on external resources which will delay application of the specifications. External resources should preferably be used for very specific tasks.

Related requirements

To build strong CIM/CGMES knowledgeable ENTSO-E/TSOs/RSCs community improving skills on CIM and data exchange profiles in order to apply CGMES releases timely and develop them in the right direction.

Implementation

Delivery of 13 training sessions (each for 9 participants) in 2018. Additional sessions are to be planned for the following years. Setup CIM SharePoint with accessible content. Update ENTSO-E website to have a coherent organization of the CIM deliverables.

Release date

This is a continuous task.

8.1.3. SharePoint documentation update / ENTSO-E website update

Description

The CGMES documentation on SharePoint is spread in several different locations, many members complain, and it leads to misunderstandings and confusions. Recently ENTSO-E website was updated but CIM section needs improvements to be oriented to specific topics. Archive part should also be restructured providing full details on the announcements and decisions (traceability).

Related requirements

It is required to have all the CGMES information in one place used by the CIM EG and accessible by the users of the CGMES. ENTSO-E website needs to be clarified to give a proper access to the correct documentation.

Implementation

ENTSO-E secretariat will build the CIM EG SharePoint and transfer all the documentation to the new SharePoint. There will be redirection of some form from the old webpages for a certain period of time (to ensure accessibility of the content in the new place) and the content itself will be deleted to avoid confusion. An archive will be kept to avoid losing data. On ENTSO-E website, the layout to access the published documentation will be harmonized with the EDI library in anticipation of the CIM EG creation.

Release date

This is needed before the start of the CIM EG end of 2018

8.1.4. ToR of the CIM EG

Description

At the time of writing this CGMES roadmap, no group is responsible of the CGMES standardization. An entity in ENTSO-E is needed to perform the CGMES roadmap.

Related requirements

It was advised by the Digital committee to group all the data exchange standardization in one group. As the group will be cross Committee, it has to be an expert group. It was therefore proposed to create the CIM Expert Group responsible of the implementation of the CGMES roadmap and containing the current scope of EDI. The CIM EG would have subgroups, taskforces or project teams to perform its tasks efficiently.

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Implementation

The Terms of Reference of the CIM EG have been drafted by ENTSO-E secretariat and are now circulated inside ENTSO-E community. The CIM EG ToR will be sent to the Digital committee on the 2nd of September 2018 and then should be submitted by ENTSO-E Secretary General to the Board in September 2018.

Release date

It is planned that the CIM EG will be launched by the end of 2018.

8.1.5. Active participation of ENTSO-E to IEC TC57 WG13

Description

In order to promote all the work that will be carried out in the frame of the CGMES roadmap, to ensure that IEC standards and specifications meet the requirements by the EU legislation and the challenges in the development and operation of the European power system, it is necessary to have a proactive role of ENTSO-E in the IEC TC57 WG13.

As the IEC technical specifications are valid for limited period of time, next editions of the IEC TS 61970-600 shall be planned and synchronised with the following releases of IEC standards:

- IEC 61970-301
- IEC 61970-302
- IEC 61970-452 Ed4 (CIM Static Transmission Network Model Profiles)
- IEC 61970-453 Ed2 (Diagram Layout Profile)
- IEC 61970-456 Ed2 (Solved Power System State Profiles)
- IEC 61970-457
- IEC 61970-303 Ed1
- IEC 61970-459 Ed1
- IEC 61970-460 Ed1
- IEC 61970-552

Related requirements

Standardization of the CGMES to reflect on EU legislation and TSOs requirements. To have IEC standards for the Common Grid Model data exchanges. To facilitate fast development of CGMES implementation for new business processes. To ensure backward compatibility of CGMES while upgrading to newer versions of canonical model. To have ENTSO-E extensions included in the IEC standards.

Implementation

Participation to WG13 physical meetings and weekly modelling calls. Detail follow up and involvement in the IEC CIM related standards and modelling work. Active involvement in the discussions of CIM issues by bringing relevant TSO expertise.

Release date

Continuously.

8.1.6. Organization of IOPs

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Description

For each version of the standard/specification, an IOP should be organized to test the proposed release using prototype or early implementation applications. This is also necessary to find and resolve at early stage issues, which in the end contributes to the broad adoption of the standards.

These IOPs have different nature as compared to the tests performed in conformity testing (FAT and SAT) where issues are also discovered. IOPs organised in the frame of TYNDP or CGM activities are IOPs of SAT kind and involve exchange of real datasets and tools that passed conformity assessment, i.e. mature enough to be challenged with real data sets.

The IOPs that validate the specification are IOPs before the FAT testing and actually before any approval of the specification. These IOPs are using test data commonly prepared by suppliers and ENTSO-E. This test data is then a basis for conformity related testing namely FAT stage testing.

Related requirements

To standardize the CGMES by ensuring wider consensus not only among TSO community, but also suppliers' community.

Implementation

Organization of IOP after preparation of a draft version of the CGMES.

Release date

Continuously.

8.1.7. Collaboration on CIMdesk

Description

CIMdesk is a tool used by all TSOs to perform quality check on datasets using CGMES, i.e. datasets received by other TSOs or exported by their own tools.

Currently, the interaction with the supplier and maintenance contracts of the CIMdesk are managed by the ENTSO-E Secretariat. As CIMdesk will be more and more used also by experts involved in operational planning data exchanges, it is necessary to have a clear process to gather requirements on the development of CIMdesk and steer the releases of the application.

Related requirements

Currently CIMdesk is limited only to perform CGMES syntax related checks. There is a need for TYNDP process to include also business checks that are specific to TYNDP and CGM.

The functionalities to be included in a next version of CIMdesk need to be driven by all the users of the CGMES. CIMdesk validation checks shall be based on quality rules and CGMES releases approved by ENTSO-E.

Under the implementation of TYNDP specific checks in CIMdesk (in particular for the net interchange checks) have been implemented. For instance, there is a specific requirement of standardizing in a unique way the value of attribute modelAuthoritySet for each TSO. The idea is to have a fixed list of admissible values, common to both operational and planning processes.

Implementation

In the frame of NMD-CIMdesk integration project, an activity has been started to extend the functionality of CIMdesk in order to include TYNDP related business checks inside the tool. Further development needs to be organised to include rules from new releases of CGMES and quality rules documents
CIM EG will be used as the means of coordination of CIMdesk development in a collaborative way.

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Release date
The task shall be completed by the end of 2018.

8.1.8. Support for the implementation projects

Description
For any project using the CGMES, the CIM EG should provide some support to the implementation projects to enable the implementation of the CGMES. This support can be in various ways: occasional participation to users' WG, consideration of change requests, clarifications, etc.

Related requirements
ENTSO-E priority is the implementation of the network codes and it is important that the implementation projects find the appropriate support for the implementation of the data exchange standards.

Implementation
NA

Release date
From beginning of CIM EG.

8.1.9. CIMContextor governance group

Description
CIMContextor and CIMSyntaxGen are tools developed by Zamiren used to create and maintain CGMES profiles. By agreement between ENTSO-E and Zamiren these tools are open for further development not necessarily by Zamiren. A governance group was established by ENTSO-E to steer the development and maintenance of these profiling tools.

Related requirements
To evolve the profiling tools in a way to be user friendly and enable interoperability among different profiling tools which will support the modelling work related to the CGMES and IEC specifications and standards.

Implementation
CIM EG shall closely follow the development of the profiling tools and suggest new requirements to be implemented.

Release date
The task is performed continuously.

8.2. CGMES Consolidate and prepare tasks

8.2.1. Investigate issues solved after the freezing of CGMES 2.4.15

Description
After the approval of CGMES 2.4.15 in Aug 2014 issues were solved by either issuing implementation guides or extending and preparing new CGMES release (UML model). For instance, CGM program had additional requirements to meet in order to serve operational planning processes. In addition, there are several issues in the dynamics model that have been corrected both in the draft CGMES as well as in CIM 17 but not CGMES 2.4.15. On the other hand, CGMES was frozen and no additional (UML model) releases were published, but an enhanced (paper) version of CGMES 2.4.15 has been published as IEC TS 61970-600 Ed.1, which still does not contain all the issue resolutions. This altogether had a negative effect on the whole process and implementers have to follow multiple documents in order to find out the right implementation description.

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The issues that have been resolved can be found in the document "CGMES_Issue_list_Change_log.xlsx" than can be downloaded from the ENTSO-E Extranet [15]. ENTSO-E is working on a procedure to have the publicly available version updated regularly.

In addition, it is necessary that CGM WP 4 and TYNDP project add their issues, in case they are not included in the list.

Related requirements

The issues are low level errors that are difficult to relate to a requirement.

Implementation

Relevant issues are factored out in a to do list that is like an issues list. This work is most efficiently carried out by a single person with capacity of 0,2 FTE. Involvement of TSO and RSC experts will be necessary to avoid overlapping activities and be more efficient in the execution of the task.

Release date

The task shall be completed in Q3 2018 and the result included in "Consolidate" release.

8.2.2. Investigate CIM 17

Description

Some issues may already have been implemented in CIM 17. IEC TC57/WG13 also got direct input from ENTSO-E on issues that have been corrected in CIM 17. However further analysis of the current version of the CIM17 is necessary in order to ensure that it is in line with CGMES development and it is not conflicting with it. It is a prerequisite to the following activities.

Related requirements

To have IEC TS 61970-600-1:2017 and 61970-600-2:2017 covered by IEC standards as by the IEC by laws. In general, to ensure that data exchanges required by EU legislation can be fulfilled by CGMES based on IEC standards.

Implementation

There is an issue list and change log for CIM 17 that shall be reviewed concerning corrections related to IEC TS 61970-600-1:2017 and 61970-600-2:2017 as well as considering related implementation guides. Relevant corrections or differences resulting from the analysis are factored out in a to do list that is like an issues list.

Release date

The task shall be completed in Q3 2018 and the result included in "Consolidate" release.

8.2.3. Incorporate nonstandard CGMES 2.4.15 information into the standard

Description

Incorporate nonstandard CGMES 2.4.15 information in the standard.

The documents (in chapter 5.4) contain both normative as well as explanatory text that should be present in the standard documents (and some of it in UML model). Documents where the information may go are

- IEC TS 61970-600, mainly part 1, however profile related issues will be reflected in part 2.
- IEC 61970-301, mainly the text template
- IEC 61970-302 if applicable
- The profile documents (IEC 61970-452, -456 and -453)

Related requirements

The references to related requirements depend on the concerned text and tracking back to requirements in network code documents must be made per text section while the work is being made.

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Implementation

The CGMES 2.4.15 nonstandard documents need to be reviewed and corresponding target documents identified. Then the text needs to be adapted and fitted to the target document. This is potentially a substantial effort.

In case the CGMES profile UML needs to be updated those updates are recorded in a to do list that is like an issues list.

Release date

The task shall be completed not later than July 2019 as a part of the IEC TS 61970-600 1&2 Ed2 "Consolidate". The Technical Specification of IEC has an update deadline, otherwise it is removed. For the CGMES technical specification, the deadline is 2019.

8.2.4. Create a revised CGMES profile UML

Description

The last official UML was issued with the approval of CGMES 2.4.15 in Aug 2014. Since then both CGMES and CIM have evolved as discussed in previous sections.

Related requirements

The references to related requirements depend on the concerned UML. Tracking back to requirements in network code documents must be made per change, while the work is being made.

Implementation

The result from reviewing other documents according to previous sections result in a to do list. The reason not to do the UML changes directly is that the number of sources that may impact the UML and the number of involved people are many. A to do list ensure proper review and agreement on the changes to be made. To start with, the last approved documentation has to be gathered in one place on the SharePoint of CIM EG.

Release date

The task shall be completed in July 2019, but interim version of the UML will be created before that. This is then considered as a final UML reflecting the published IEC TS 61970-600 1&2 Ed2 "Consolidate".

8.2.5. Revised CGMES profile in RDFS and related CGMES version documentation

Description

Once the profile UML has been revised the corresponding RDFS shall be created. HTML and CGMES specification documents shall be generated as well.

Related requirements

The references to related requirements depend on the concerned UML and tracking back to requirements in network code documents must be made per change while the work is being made.

Implementation

This is a simple mechanical task that still may take some time.

Release date

The task shall be completed in July 2019, but interim version of the RDFS will be created before that. This is then considered as a final RDFS reflecting the published IEC TS 61970-600 1&2 Ed2 "Consolidate".

8.2.6. Translate the QoCDC English text rules

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Description
As interoperability tests among TSOs using real datasets are carried out, issues have been discovered. The Quality Portals (QAS) that validate and check IGM and CGM data are expected to find and report these issues. The Quality Portals are currently based on "QoCDC 2nd edition". The QoCDC documents describe errors in IGM/CGM data in two ways

- By referring to machine processable rules describing constraints on the CGMES profiles.
- By English text in the QoCDC documents.

This resulted in requests that the English text rules shall be expressed so that they can be translated into machine processable code that does validation.

Translate the QoCDC English text rules in "QoCDC 2nd edition", "QoCDC 3rd edition" and "QoCDCv3-changes.docx" into

- Machine processable rules in the CGMES profiles UML
- Documentation on related UML classes, attributes and roles or IEC TS 61970-600 part 1.

Related requirements
The references to related requirements depend on the concerned machine processable rule and tracking back to requirements in network code documents must be made per text section while the work is being made.

Implementation
This is potentially a substantial effort where new machine processable rules need to be created and explanatory text added in the UML profiles as well as in IEC 61970 documents, e.g. -302 and -600 part 1. As the rules in the QoCDC documents are reviewed, those changes can be recorded in a to do list.

The effort is most efficiently done by a person with experience of machine processable as well as UML classes and simple profiling (like for CGMES).

Release date
The task shall be completed in October 2018 and the result included in "Consolidate" release.

8.2.7. Change the QoCDC document to describe error reporting only

Description
Change the QoCDC document to describe information related to error reporting, e.g. report layout and attributes related to the report itself, e.g. severity and process where the error may occur. Currently error reporting in "QoCDC 3rd edition" is described by XML Schemas.

Related requirements
This is a low-level requirement probably not covered by network code related requirements.

Implementation
This is a simple task where all the rule related information is removed from the QoCDC document. After this the document will be small and is added as a section in IEC TS 61970-600 part 1.

Release date
The task shall be completed in October 2018 and the result included in "Consolidate" release.

8.2.8. Update of CGMES Conformity Assessment Scheme

Description
Conformity assessment process for Suppliers' applications relevant for TSOs was developed and approved in 2014 in order to verify if their applications are in line with last published version of the CGMES. The conformity assessment covers so called FAT (factory acceptance test) and SAT (site acceptance test) testing. FAT is the tests performed by suppliers before they issue a declaration of

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conformity. ENTSO-E is issuing an attestation of conformity after performing a review process. The SAT testing is done with real datasets and by organising TSOs involved in specific business process, e.g. operational planning or TYNDP.

Related requirements

To ensure adequate validation of the applications supporting CGMES by delivering clear testing rules, procedures and datasets. To make sure that SAT tests have representative datasets that can be used to test both exchanges in CGM and TYNDP processes.

Implementation

Last version (v2.0.0) was published in November 2017. Some suppliers and TSOs informed ENTSO-E on issues in both test data and documentation. The work to fix these issues should be structured and completed. The development of next releases of the conformity assessment scheme shall follow CGMES development so that every time there is a draft version of the CGMES ready for testing, there is also a draft version of conformity assessment scheme which reflects the CGMES version.

Substantial work will be needed to prepare real datasets that can be used in SAT testing for CGM and TYNDP processes.

Release date

Updated conformity assessment scheme shall be ready by Q4 2018, applicable to the 'Consolidate' release. Next releases shall follow CGMES version releases.

8.2.9. Update the documentation for the conformity assessment for the EMF

Description

The conformity assessment scheme updated in Nov 2017 did not include test use cases related to EMF testing, developed by CGM Project. The reason is that some of the requirements and why to test them were still under development. These additional test use cases shall be included in the conformity assessment scheme in its next update.

Related requirements

To have a consolidate version of the ENTSO-E conformity assessment scheme covering both basic data exchange function and more specific operational planning related data exchanges.

Implementation

CIM EG will be used as the means of coordination to guide further development of the conformity assessment documentation in a collaborative way. A separate project or task force might need to be created in order to gather relevant expertise and have proper allocation of resources.

Release date

It is expected to have a release of CAS including EMF test use cases in Q1 2019, applicable to the 'Consolidate' release. Necessary updates will follow according to the CGMES releases.

8.2.10. Maintenance and support for the Common Grid Model program

Description

The Common Grid Model program is currently implementing support for exchanging IGMs that are merged into CGM using CGMES. Support and guidance is needed in regard to the use of CGMES and transition to CGMES version that supports the requirements.

Related requirements

The high-level requirements for the IGM and CGM are defined in the approved Common Grid Model Methodology (CGMM) and Generation and Load Data Provision Methodology (GLDPM).

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Implementation

The requirement needs to be compared with the current CGMES 2.4 to identify the gap. The result of the gap analysis need to be presented to the CGM program for agreeing on the minimum set of requirements that need to be addressed, before addressing the requirements given by the different business processes that will be using CGM. With this common understanding between CIM EG and CGM Program, necessary mitigation activity of supporting the CGM program in the implementation of CGMES can be defined and executed.

Release date

The gap and priority list for the minimum support of CGMM and GLDPM are expected to be ready Q2 2019 as a part of the IEC TS 61970-600 1&2 Ed2 "Consolidate" or to prepare for NC+ release. Necessary updates will follow according to the CGMES releases.

8.2.11. Maintenance and support of the Pan-European Verification Function Project and CGMA function

Description

The Pan-European Verification Function (PEVF) and the Common Grid Model Alignment (CGMA) Function both serve to support the European Merging Function (EMF) in its task of producing the Common Grid Model. The PEVF is used to exchange the data resulting from the market settlement, in the intraday and day-ahead time horizons, while CGMA is intended to be used for all the other time horizons for which the market settlement results are not available.

Both PEVF and CGMA implementations are based on EDI standards and specifications, but they differ from each other even though the data exchanged is the same. Furthermore, they both require mapping to CGMES network models. It is therefore important to make sure that necessary items between PEVF / CGMA and CGMES can be mapped in the most efficient way that also require minimum changes in the future by implementing newer version of CGMES.

Related requirements

Common Grid Model Methodology (CGMM) and the CGM Program specification for PEVF and CGMA describe the requirements.

Implementation

Make sure that the CGMES Implementation guide initially addresses the mapping between the EDI standards and specification used for PEVF/CGMA and the CGMES, to support smooth transition to a native CGMES implementation in future version of CGMES.

Release date

The task should be completed by Q2 2019 as a part of the IEC TS 61970-600 1&2 Ed2 "Consolidate" or to prepare for NC+ release.

8.2.12. Maintenance and Support of the Short and Medium-Term Adequacy forecast (Regional processes)

Description

The Short and Medium-Term Adequacy (SMTA) is currently being implemented in different regional processes. The SMTA implementation is based on EDI standards and specifications. It is therefore important to make sure that necessary items between SMTA and CGMES can be mapped in the most efficient way. It is also important to support the implementation so that SMTA on a later stage can be implemented using CGMES.

Related requirements

Common Grid Model Methodology (CGMM) and SMTA specifications describe the requirements.

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Implementation

Make sure that the CGM Implementation guide for CGMES addresses the mapping between the EDI standards and specification used for SMTA and the CGMES.

Release date

The task should be completed by Q2 2019 as a part of the IEC TS 61970-600 1&2 Ed2 "Consolidate" or to prepare for NC+ release.

8.2.13. Support persistence of identification codes in the data exchanges

Description

In CGMES, each element (e.g. a substation) is uniquely identified by a UUID. This ID is an alphanumeric string randomly generated by using a UUID algorithm. This identification code is assigned at the creation of the element and must stay the same for the whole life of the element. The challenge here is that current implementation in SDC processes do not foresee any solution to keep those IDs persistent. According to IEC TS 61970-600-1:2017, the responsibility for persistence is agreed to be ensured by the TSOs. However multiple TSOs face different challenges and it is valuable to share experience to identify common issues that could be resolved on ENTSO-E level and specified. As the integration of applications is TSO specific, careful analysis shall be performed to identify areas for improvements. In addition, real data planning models should be provided to 3rd parties, according to 3PQT Guidelines, to ensure that testing of persistency is verified. A round trip of real IGMs or assembled models can support the validation at later stage. Clear distinction on the requirements for bottom-up and top-down scenarios about the persistence should be made.

Related requirements

Support the network code implementation by ensuring persistent codes within ENTSO-E processes.

Implementation

CIM EG will coordinate the activity and gather a team to find out the best practices.

Release date

The activity is launched in Q1 2019. Report on the identification codes and roadmap for ENTSO-E identification system is expected in Q2 2019. It can be considered in the IEC TS 61970-600 1&2 Ed2 "Consolidate" or in the NC+ release.

8.3. CGMES Standardize new functions tasks

8.3.1. Gap analysis from the network code to ensure their full coverage by the standards

Description

All the 8 Network Codes, grouped into Connection, Operations and Market, have entered into force. All information exchange required by the network codes needs to be supported by CIM standard governed by CIM EG, either CGMES or ESMP based. This task will focus on identifying the gap and propose specification that covers the gap for all exchanges between TSO and RSC that will use CGMES.

Related requirements

The Network Code requirements are for most areas further specified in different Methodology and Supporting documents. The following Methodology documents are considered the requirement for this task: Common Grid Model Methodology (CGMM), Coordinated Operational Security Analysis Methodology (CSAM), Capacity Calculation Region Methodology (there could be up to one methodology per region). Not all documents have been approved or fully developed yet. This task cannot be finished before all relevant documents get approved.

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Implementation
Identify the gap between the requirements and the current version of CGMES. Make a draft proposal on potential solution and make estimate for development of the specification that solves it, development of necessary test data and test cases to verify vendor implementation.

Release date
Q1/2019, applicable to "NC+" release.

8.3.2. Development of process diagram related to the SO GL

Description
Write a process diagram of the SO GL: It should include all the information flows required by SO GL (for all the processes: CGMM, CGMA, PEVF, EMF, SMTA regional and pan-European, OPC, CSAM, RAOCM, CCC, etc.).

Related requirements
To ensure the consistency of the development of the data exchanges related to the SO GL, it is needed to have a high-level view of all the exchanges.

Implementation
Market Integration Working Group has already done a process diagram for the FCA, CACM and EBGL Network codes. The proposition is to collaborate with the SOC WGs to develop the same kind of process diagram.

Release date
The process diagram is needed to have a good quality data exchange standardization of the SO GL processes. It is applicable to "NC+" release.

8.3.3.Inclusion of implementation guide for Coordinating Operational Security Analysis

Description
The gap analysis done in 8.3.1 for CGMES to support the Network Code (NC) provides the input to this task. The gap needs to be implemented to the standard.

Related requirements
The requirements are defined in Common Grid Model Methodology (CGMM) and Coordinated Operational Security Analysis Methodology (CSAM).

Implementation
Specify the extension to CGMES that are needed to meet the requirement. Create test data and test cases. This needs to be embedded into an updated version of CAS. Create Utility Implementation guide for supporting CSAM using CGMES. The work includes the review and possible adaptation of draft version of CGMES profiles.

Release date
The task shall be completed in 2019, applicable to "NC+" release.

8.3.4.Inclusion of implementation Guide for Capacity Calculation

Description
In collaboration with market data experts develop the needed specification to support Capacity Calculation using CGMES according to the gap analyses performed in task 8.3.1

Related requirements
The coordinated capacity calculation is required by the network codes (CACM and SOGL). Each region shall write a methodology for coordinated capacity calculation. The more detail requirements are

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defined in Common Grid Model Methodology (CGMM) and each of the regional capacity calculation methodology.

Implementation

Specify the extension to CGMES that are needed to meet the requirement. Create test data and test cases. This needs to be embedded into an updated version of CAS. CIM EG will help in writing an implementation guide for the coordinated capacity calculation.

Release date

The task shall be completed in 2019, applicable to "NC+" release.

8.3.5. Inclusion of the system development guidelines on network modelling

Description

In 2015 a project under SDC developed guidelines on network modelling [14]. These guidelines include business rules some of which are already included in the quality rules for CGM program, but others need to be considered. In addition, these guidelines were a basis for elaborating of TYNDP 2018 modelling guidelines. It is necessary to consider all this work and analyse which rules can be made part of the CGMES.

Related requirements

To have a harmonized validation rules and modelling practices across operational planning and long-term system development modelling activities. The validation rules should consider the specific requirements for both bottom-up and top-down long-term system development scenarios. Provide real data planning models for testing, as per requirements in 3PQT guidelines.

Implementation

Available documentation shall be analysed by a team which will also suggest modifications to the next CGMES release. The work is linked to the task of inclusion of quality rules in the CGMES. Therefore, close cooperation between different teams is expected. Expected modifications shall be recorded in a list which needs to be analysed by a modelling team in terms of finding the best place (base UML, profiles, quality rules, etc.) to implement the rules.

Release date

The task shall be performed in Q1-Q2 2019, applicable to "NC+" release.

8.3.6. Inclusion of implementation Guide for Pan-European Market Model process (PEMMDB)

Description

Market modelling data collection is necessary to perform pan-European market studies for the different ENTSO-E deliverables such as TYNDP and future market-based resources adequacy studies (MAF and Seasonal Outlook). There is a need to take in consideration network information for market studies. Today the network model is exchanged in CGMES which is a different format than the market data exchange. MAF team would like to use the same format for both market models and network models' datasets in order to have seamless and integrated data sets depicts all required information (market plus network).

Related requirements

To consolidate the information exchange and have market modelling data as much as possible included in the CGMES.

Implementation

A gap analysis between CGMES and data needed in PEMMDB shall be performed by a team that has knowledge of both types of data. Necessary adaptations shall be recorded in a list and proposed to

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CGMES modelling teams for further inclusion in the CGMES according to the releases outlines in this roadmap.

Release date

The work shall be launched in Q2 2019 in order to enable proper development and release in 2020-2021 for the benefit of TYNDP 2022. It is applicable to "Wisdom 1" release.

8.3.7. Support Outage Planning Coordination (OPC) data exchange

Description

The Outage Planning Coordination (OPC) is currently being implemented in different regional processes. The OPC implementation is based on EDI standards and specifications. Until CGM gets available from CGM program, it is important to make sure that (1) necessary items between OPC and CGMES can be mapped in the most efficient way, and (2) that the master data does not get redefined but rather reused. It is also important to support the implementation so that OPC data exchanges can be implemented using CGMES.

Related requirements

To have data related to operational planning processes and network codes related data exchanges as much as possible exchanged using CGMES in order to minimize overhead work related to external linkage to different types of data. Therefore, the objective is to eliminate the need to exchange duplicate master data, and with different format.

Implementation

A team shall analyse the feasibility to have a subset of EQ profile from CGMES to cover the needs of a data exchange from OPDM to OPC in the future. Through project work, Swissgrid committed to provide a draft profile. Review shall be organised with CGMES experts as well as EDI experts. The work includes the review and possible adaptation of draft version of CGMES profiles.

Release date

The task shall be completed in 2019, when OPDE is ready to provide CGM to the OPC. It is applicable to "NC+" release.

8.3.8. Finalise draft CGMES profiles from July 2016 IOP

Description

Draft CGMES version used in the IOP 2016 had included new profiles in support of Network Codes (including SIPS, contingency definitions, bidding zone data, outage planning) as well as to support general network model exchanges applicable to both TYNDP and operational planning scenario specifications (variation-project exchange, manifest). The following items have to be considered when finalising the profiles:

- Dynamic rating in SSH was already taken care of in the new 61970-456, but not yet in CGMES
- Energy connections instead of energy consumers, generating units, energy sources, external network injections
- Connectivity nodes in all EQ models, not just in node breaker models (this is currently being discussed in WG13), necessary for the model exchange of mixed detail
- SvVoltage associated with terminals instead of TopologicalNodes (creates independence of TP profile and TopologicalNodes created by different sources)
- PowerElectronics to be added
- Operational limits for all energy connections
- Inclusion of SIPS

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- Inclusion of monitoring list and contingency list

The work on these draft profiles has been frozen and needs to resume.

Related requirements

Various methodologies and business processes heavily depending on network model exchanges (IGMs, CGM) and scenario creation for security analysis and flow-based capacity calculations – i.e., anything that needs calculations based on network models. All should use the native CGMES modelling without need for mapping to other master model and different formats.

Implementation

Together with EDI experts, finalise and / or consolidate profiles as extension to CGMES that are needed to meet the requirements.

Release date

The task shall be completed in 2019, along the "NC+" release of CGMES.

8.3.9. Support of complex control models and schemes

Description

CGMES is lacking support related to modelling of complex control models (e.g. Voltage-Droop control or master/slave concept). It is necessary to review the setup of the RegulatingControl, gather additional requirements, analyse them and propose CGMES improvements.

Related requirements

More detailed representation of the control schemes is necessary for exchange of more detailed models especially in cases these models need be used for specific studies.

Implementation

A task force to be created to gather requirements and the ways to model control logics in different software packages analyse them and propose CGMES improvements.

Release date

The team shall be formed in Q1 2019 and deliver in Q4 2019. Depending on the need and the proposed solution, the result can be included either in "Wisdom 1" or "Wisdom 2" release.

8.3.10. Review HVDC modelling

Description

CGMES 2.4 and its further developments by 2016 need revision on the HVDC modelling. In 2014-2016 input from TSOs, IEC WG13, IEC HVDC standards and vendors' information were used to design CGMES. However, implementation of CGMES shows gaps in HVDC modelling.

Related requirements

Well tested HVDC models for load flow and dynamics are needed for CGM and TYNDP exchanges.

Implementation

A task force to be created to gather requirements analyse them and propose CGMES improvements. The task force needs to interact with IEC groups responsible for HVDC modelling.

Release date

The team shall be formed in Q1 2019 and deliver in Q1 2020. Proposed improvements shall be included in 61970-302, 61970-457, 61970-301, 61970-452, 61970-456 by Q3 2020. It is applicable to "Wisdom 2" release although some improvements can be considered in "NC+" and "Wisdom 1" releases.

8.3.11. Organise HVDC testing

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Description
Before and during the task to review HVDC modelling it is necessary to test existing models to identify gaps and test new proposals.

Related requirements
Needed for CGM and TYNDP exchanges.

Implementation
A project with participation of vendors and IEC (WG13 and HVDC group) shall be launched. This project shall work in close cooperation with the task force for reviewing HVDC modelling.

Release date
The team shall be formed in Q1 2019 and deliver in Q1 2020. Proposed improvements shall be included in 61970-302, 61970-457, 61970-301, 61970-452, 61970-456 by Q3 2020. It is applicable to "Wisdom 2" release although some testing can be considered for "NC+" and "Wisdom 1" releases, if modifications are included in these releases.

8.4. CGMES Full integration tasks

8.4.1. European System Operation Role Model

Description
Network codes and guidelines define many actors and their roles. In order to design a stable data exchange solution, it is necessary to prepare role model and to properly present interactions between actors.

Extract a European system operation model based on the network codes and guidelines. These roles are to be presented in a modelled way.

Related requirements
To have interactions defined in network codes transformed to a role model that is a basis for further development of fully integrated data exchange among all actors.

Implementation
A team shall be established to extract relevant information from network codes and guidelines and propose a role model. The team (ESORM) related to the development of system operation guidelines (SO GL) is already planning to launch the work in Q4/2019.

ESORM shall be compliant and work close to EEMRM (European Electricity Market Role Model)

Release date
As work will be launched in Q4 2019 the completion is expected in 2020. It is applicable for "Wisdom 1" or "Wisdom 2" releases, however final solution might be realised in "Future" release.

8.4.2. Dynamics profile update

Description
Edition 1 of 61970-302 was published in 2018. The release of the 61970-457 is in process. There is a need to start the preparation of the edition 2 of the mentioned standards in order to include models from IEEE 421.5-2016 and add all other improvements related to the DY profile (for instance, HVDC, load representation, wind, power electronics, etc.). Moreover, there are no statements on how a tool shall represent EquivalentInjection and ExternalNetworkInjection in a dynamic simulation. Due to the break down by fuel type the long-term planning models comprises around 20,000 SynchronousMachines which will severely impact the simulation performance. Probably, even simpler models than SynchronousMachineSimplified are required.

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Related requirements
Necessary to cover new requirements related to CGM and TYNDP exchanges.

Implementation
A task force shall be established to gather requirements and propose CGMES improvements. Interaction with projects related to DY profile update is necessary. This task could be done in collaboration with (or as part of) a research project.

Release date
The work is launched in Q2 2019 and updated standards are expected in Q3 2020. It is applicable to "Wisdom 1" release with final solution in "Future" release.

8.4.3. Dynamics profile: test user defined models

Description
User defined models approach is available in CGMES, but it needs to be tested with prototype tools. In case issues are detected these shall be recorded and planned for next CGMES releases.

Related requirements
The need to demonstrate user defined models exchange and suggest further development

Implementation
Organise IOP/workshop with vendors. This task could be done in collaboration with (or as part of) a research project.

Release date
Schedule the IOP/workshop in Q3 2019. It is applicable to "Wisdom 1" release. Additional workshops can be scheduled ahead of "Wisdom 2" and "Future" releases.

8.4.4. Dynamics profile: support the testing

Description
Since many years ENTSO-E is running an effort to implement dynamics profile of CGMES. Vendors representing main software applications take part in the effort. So far, this process contributed significantly to the maintenance and improvement of the dynamics profile and was possible to release 61970-302 and prepare 61970-457. However, additional funding is necessary to boost the effort and perform more detailed testing.

Related requirements
This helps to improve the exchange related to DY profile and issue clearer standards.

Implementation
Prolong existing ENTSO-E effort and ensure funding. Involve universities in the process. This task could be done in collaboration with (or as part of) a research project.

Release date
The effort shall be funded from Q1 2019. Testing and documentation shall be delivered by July 2019. A second round of testing shall be planned for Q1 2020 and documentation shall be delivered by July 2020 to feed into the standardisation process (Ed 2 of 61970-302 and 61970-457). It is applicable to all releases from "NC+" to "Future".

8.4.5. Enhance representation of power electronics and update wind modelling

Description
IEC is updating wind modelling related standards. The CGMES needs to follow this and integrate new functionalities. Modelling of power electronics and FACTS shall be improved.

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Related requirements
Cover new IEC standards on wind and detail power electronics modelling.

Implementation
A task force shall be established to gather requirements and propose CGMES improvements. This task could be done in collaboration with (or as part of) a research project.

Release date
The task force is launched in Q1 2019. Testing of the new approaches shall be done in Q3 2019 and standard released in Q4 2019. It is applicable to "Wisdom 1" release, however final solution might be applied in "Future" release.

8.4.6. Review and improve load representation in main and DY profiles

Description
Load modelling in CGMES needs a review and improvement is necessary in order to reflect new requirements. Some projects are having detailed analysis and the outcome shall be included in CGMES to be able to benefit in the data exchange.

Related requirements
Cover new requirements for load representation

Implementation
A task force shall be established to gather requirements and propose CGMES improvements. Interaction with projects related to load modelling is necessary. This task could be done in collaboration with (or as part of) a research project.

Release date
The task force is launched in Q1 2019. Testing of the new approaches shall be done in Q3 2019 and standard released in Q4 2019. Some of the modifications can be applied in "NC+" release in respect to load modelling. Other improvements will be realised in "Wisdom 2" or "Future" releases.

8.4.7. Update and harmonize Boundary Management System

Description
The current version of boundary management system (BMS) was developed to be a reference system for all data related to boundary points. It was initially used for long term planning data exchanges (TYNDP). With the approval of the network codes, new requirements were defined based on operational planning data exchanges. These initial requirements were implemented in the system and a process related to the data maintenance and interactions between ENTSO-E Secretariat and RSC was developed. Due to other priorities in the frame of CGMES implementation some of the newly introduced functionalities were not well tested and the process that was agreed was not fully implemented and backed with necessary resources. In addition, some complimentary requirements were collected which needs to be analysed and implemented in the system. For instance, further development of the system to be able to store more data related to the HVDC links might be necessary in order to standardise the modelling/representation of the HVDC for a given exchange.
It is important to note that BMS hosts more information than needed to the CGMES boundary set and the reason for this is to enable data control and quality checks related to the cross-border interconnections. It also covers other use cases, for example, related to historical and statistical information on cross border interconnections. The generation of the boundary sets for different data exchanges is just one of the main functionalities. With the development of the CGMES and introduction of profiles like "manifest profile" the boundary profiles will be depreciated over time. However, a reference system to maintain boundary information will always be needed to allow TSOs to agree on commonly shared information. With the increasing of the maturity of the data exchange and the involvement of additional actors' boundary information becomes more and more crucial for the

exchange, thus continuous development is expected to occur and revision of the boundary concepts might also be planned.

Related requirements

To have a well-tested and stable reference system to maintain boundary information used for all data exchange processes in the TSO community.

Implementation

A team shall be established to analyse the requirements and define what should be implemented in the boundary management system. The task to gather and analyse the requirements would not require many resources, however the implementation and further integration with OPDE shall be carefully planned to ensure availability of the system at the time required by the business processes.

Release date

The task shall be launched in Q3-Q4 2018 and new release shall be planned in 2019. It is applicable to "NC+" release to be used with OPDE, however additional improvements might still be necessary considering functionalities of "Future" release.

8.4.8. Assessment UML model for the error reporting

Description

Optionally develop a UML model for the error reporting that is used to generate the XML Schemas describing the error reports. This may be a tedious effort as several stake holders may have an opinion.

Related requirements

This is a low-level requirement probably not covered by network code related requirements.

Implementation

This effort will need a task force, possibly including TC57 CIM working groups.

Release date

The task shall be completed in July 2019. It is applicable to "NC+" release, however each release might require modification of the approach due to new requirements.

8.4.9. Reference implementation of CGMES validation

Description

Many TSOs need offline tools to validate their models. Each tool provider is looking in to implementing the validation rules and many of them do not use possibility to generate from UML + OCL. Currently ENTSO-E has to order code development each time the rules or standard changes to the tools (like QAS or OPDM) themselves. Instead of a onetime development of a tool to convert UML+ OCL to a XML schema that in turn can be pushed to all relevant tools. It will be more efficient if ENTSO-E updates the rules in central tools (QAS, OPDM), which would enable to integrate new rules to tools quickly instead of procuring new development to hardcoded rules each time.

Therefore, it is necessary to have a programming language to perform independent and flexible XML validation. This would enable a simple way to implement, share and update validation rules.

Related requirements

To have necessary tooling to support flexible testing and implement changes to rules easily by modifying the rules description file.

Implementation

The main implementation tasks are:

- Choose suitable XML schema definition standard
  - XSD + xpath
  - XSLT

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- XSD + MQL - Solution used by CIMdesk, probably not suitable, as MQL is not widely supported - https://www.ibm.com/support/knowledgecenter/en/SSPLFC_7.3.0/com.ibm.taddm.doc_7.3/SDKDevGuide/c_cmdbsdk_mql_introducing.html or http://www.powerinfo.us/publications/MQL_Tutorial.pdf
- Something else

- Acquire tool for converting UML + OCL to chosen XML schema definition

It is important that ENTSO-E maintains the UML model and if needed generates new validation rules which are uploaded/distributed to tools (like QAS or OPDM) and other participants. Basically, in this way there would be a reference validation implementation, everyone can do their final code generation directly from UML (if they need to), but at the same time anyone could run and test the rules in any programming/scripting language or even in some more advanced IDE/xml editor.

Release date

The task shall be completed in 2019. It is applicable to "NC+" release, however each release might require modification of the approach due to new requirements.

8.4.10. Collaboration with TDX-ASSIST research project

Description

TDX ASSIST is a research project that investigate use cases with TSOs and DSOs and the data exchanges that could be needed in the future. The project, with the aim to propose potential improvements to the CIM UML, will provide network model CIM profiles appropriate for IEC approval. Harmonisation and CIM issues will be identified. The development of TSO-DSO interoperability, pursued by project's deliverables, based on the well stablished CGMES and the ENTSO-E Harmonized Role Model Data Exchange fundaments, will help to collect requirements for CGMES,

CIM standards and CGMES profile modifications will be specified for TSO-DSO interaction use cases identified in the project. These proposed modifications will be suggested to the CIM EG for consideration.

Related requirements

To support TSO-DSO data exchange by evaluation of different data specification (CIM standards and CGMES), through modelling data exchange between TSO and DSO, power system and other stakeholders.

Implementation

Involve the TDX-ASSIST research project results with CIM EG. Propose updates in CIM standards and CGMES profile to fit with use cases with the distribution grids, complete the specification for the use cases identified on the tasks of the project, based on the outcome of the field testing. Some of the results will be:

- Creation of a Deliverable Report Specifying a UML and profile description to fulfil this objective, create network model profiles of distribution grids, to enable further development of TSO-DSO data exchange use cases. Evaluate profiles against relevant IEC standards and industry practice.
- Recommendation report on system equivalents/reduced models, identifying harmonisation issues for a CIM implementation to carry forward use cases dealt with the task proposed, critically evaluate that the implementation meets TSO and DSO interaction.

Release date

This work was launched on September 2017, some deliverables are expected for Q2 of 2018 and the project will finish in Q3 of 2020. It is applicable to "Wisdom 2" release, however final solution might be realised in "Future" release.

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8.4.11. Implement needed support in CIM for TSO-DSO exchange according to the network code

Description

Base on the result from TDX ASSIST research project (see task 8.4.10) this task will work on implementing the proposed update to the CIM standards.

Related requirements

Network Code and the outcome form TSX ASSIST for supporting TSO-DSO data exchange.

Implementation

Specify the extension/update to CGMES that are needed to meet the requirement. Create test data and test cases. This needs to be embedded into an updated version of CAS. Create Utility Implementation guide for TSO-DSO exchange using CGMES and EDI CIM.

Release date

This work will finish in Q3 of 2021. It is applicable to “Future” release, although some improvements can be included in “Future” release.

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9. Resources

The roadmap defines multiple tasks for the next 5 years. Many of these tasks are to be performed continuously or have repetitive character along the years. This definitely requires appropriate level of resources available in the ENTSO-E Secretariat as well as flexible (to some extent) resourcing from TSOs in order to able to gather necessary expertise quickly.

It is hard to quantify the needed resources at this stage, however the Secretariat and the CIM EG will monitor the progress and will issue periodic forecasts for resources needed for the following 6 months to 1 year. That would support resources planning to some degree.

There are three main drivers in terms of resources that were found as a prerequisite to the implementation of the CGMES roadmap:

- An appropriate level of resources in ENTSO-E secretariat in terms of FTE and budget
    - The CGMES roadmap confirms the forecast from ENTSO-E budget planning process for 2019
    - Although it is expected that similar budget should be foreseen for 2020, a reassessment of the budget for 2020-2021 is necessary to consider potential benefits in using outcome of various projects and take into account the needs for “NC+”, “Wisdom 1” and “Wisdom 2” releases of the CGMES.
- An appropriate level of contribution from the TSOs
    - The CIM EG is meant to gather the contribution from the TSOs to perform the CGMES roadmap
    - Many of the tasks defined in the roadmap will be performed in small projects, task forces, or sub teams in CIM EG which will require gathering relevant experts. TSOs need to be ready to allocate some resources answering calls for experts on different tasks.
- A continued training program to increase the level of expertise in CIM
    - Trainings on CGMES started in 2018 by the CGM program should continue as per the task 8.1.2

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10. References

[1] SOC session file of November 2013, see TOP 5

[2] ENTSO-E Standard CGMES 2.4.15

[3] CGMES at public ENTSO-E site (as of this writing: https://www.entsoe.eu/digital/cim/cim-for-grid-models-exchange/)

[4] CIM ENTSO-E IOP site at CIMug (login required: http://cimug.ucaiug.org/Groups/ENTSO-E_IOP/default.aspx)

[5] CIM user group: http://cimug.org

[6] 6th ENTSO-E CGMES Interoperability Test Report, July 2016: https://www.entsoe.eu/Documents/CIM_documents/IOP/160715_CGMES_IOPreport2016.pdf

[7] Quality of CGMES Datasets and Calculations.pdf

[8] IEEE Power & Energy magazine, Jan/Feb 2016, "The Root of All Data Exchange: Common Information Model" (login required: http://magazine.ieee-pes.org/january-february-2016/)

[9] Roadmap for Implementation of the CIM/XML data exchange format for system operations and system studies exchanges. Approved by ENTSO-E System Operation Committee and ENTSO-E System Development Committee in Nov-Dec 2009

[10] ENTSO-E Common Information Model (CIM) Interoperability Tests, approved by ENTSO-E System Operation Committee, ENTSO-E System Development Committee and ENTSO-E Market Committee in 2009

[11] IEC TS 61970-600-1:2017 "Energy management system application program interface (EMS-API) - Part 600-1: Common Grid Model Exchange Specification (CGMES) - Structure and rules": https://webstore.iec.ch/publication/27556

[12] IEC TS 61970-600-2:2017 "Energy management system application program interface (EMS-API) - Part 600-2: Common Grid Model Exchange Specification (CGMES) - Exchange profiles specification": https://webstore.iec.ch/publication/32923

[13] package IEC 61970-CGMES:2018 "Energy management system application program interface (EMS-API) - Common Grid Model Exchange Specification (CGMES)": https://webstore.iec.ch/publication/61124 which contains IEC standards related to CGMES

[14] Guidelines on Network modelling

[15] CGMES issue list and change log

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11. Annexes

Annex A: List of items CGM WP2 has worked on after CGMES was frozen in 2014

The following list of requirements was guiding the development on CGMES in 2014-2016 under PT CGM (WP2), and most of them have already been addressed in a draft version of CGMES that extends the CGMES 2.4.15 of August 2014:

- New grid elements: Expected new grid elements for the CGM forecasting period shall be included in IGMs
- Switch type: Indicates the type of switch: ("Breaker", "Disconnector", "LoadBreak Switch")
- Level of detail: If applicable, load can be split between regular and price-dependant parts.
- Type of primary energy source : Specifies the type of primary energy source ("Biomass", "Solar", "Waste", "Wind Offshore", "Wind Onshore", "Marine", "Geothermal", "Hydro Pumped Storage", "Hydro Run of River", "Hydro Water Reservoir", "Other Renewable", "Fossil Brown Coal/Lignite", "Fossil Coal-Derived Gas", "Fossil Gas", "Fossil Hard Coal", "Fossil Oil", "Fossil Oil Shale", "Fossil Peat", "Nuclear", "Co-generation", "Other"
- Power factor control: For a power Generating Module in Power Factor control mode, each TSO shall specify maximum and minimum power factor values
- Bidding zone: It shall be clear to which bidding zone a generator belongs
- DC lines and FACTS devices: It should be possible to exchange DSA data for DC lines and FACTS devices (data on the dynamic models of the device, associated regulation suitable for large disturbances)
- Timehorizon: Indicates the time horizon of the grid condition ("Year ahead", "Month ahead", "Week ahead", "Two days ahead", "Day ahead", "Intraday", "Snapshot")
- Preparation time before timestamp: Number of hours ahead the timestamp when the scenario has been created : “6 hours ahead”, “5 hours ahead”, etc.
- Version number: Number of version
- Outaged flags: Specifies whether a Grid Element has been outaged. Outaged flag must be provided for all modelled Grid Elements, Power Generating Modules and Loads.
- Voltage limit type: Specifies the type of voltage limit ("Operational Limit", "Warning", "Alarm")
- Ordinary contingencies: Defined as the loss of a single element
- Exceptional contingencies: Defined as the loss of a busbar or more than one element such as, but not limited to: a common mode Fault with the loss of more than one Power Generating Module, a common mode Fault with the loss of more than one AC or DC line, a common mode Fault with the loss of more than one transformer
- Out-of-Range contingencies: Defined as the simultaneous loss, without a common mode Fault, of several Transmission System elements such as, but not limited to: two independent lines, a substation with more than one busbar, a tower with more than two circuits, one or more Power Generating Facilities with a total lost capacity exceeding the Reference Incident
- Critical branches: TSOs shall define a list of branches that have to be monitored during capacity calculations

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- Generation shift key: The Generation Shift Key file defines the nodes which will participate in the generation shift applied for various calculations. It can either contain the nodes that participate or the nodes that don't participate.
- Generation shift key: The GSK algorithm for balance adjustments purposes shall consider the operational limits of generators
- Generation shift key: The GSK algorithm for flow-based capacity calculation shall consider the operational limits for countries in which overload of the system is easily expected
- Generation shift key / Load shift key: Optionally a list of nodes can be defined that participate in the Load Shift. A percentage value has to be defined between GSK and LSK; in case no LSK is defined the percentage for GSK is 100%.
- RES infeed: Variations in wind infeed or Photo Voltaic infeed shall be modelled using wind shift key files and solar shift key files, respectively and where possible.
- SPS: It shall be possible to model special protection schemes
- Remedial Action: TSOs shall define the measure to be applied in order to fulfil the grid security requirements of the transmission power system regarding power flows and voltage constraints.
- Remedial Action: Grid elements or generators that are not available on short notice should not be included in the list of remedial actions
- Additional Constraint: TSOs shall define the additional operational constraint related to the control of voltage profiles and dynamic stability of the system.
- Redispatch potential: TSOs shall provide the redispatch potential in both directions for on-line generators for at least D-1 scenarios
- Redispatch potential: TSOs shall provide the redispatch potential in both directions for generators that can be started within two hours for at least D-1 scenarios
- Planned outages: TSOs shall provide a list of planned outages for relevant network elements for all agreed time horizons

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