



European Network of
Transmission System Operators
for Electricity

MIGRATION PROCESS FROM UCTE DEF TO CGMES **SECOND EDITION**

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PT CGM

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1 INTRODUCTION

In its 28th meeting, held on 28 November 2013, the ENTSO-E System Operations Committee (SOC) approved v2.4 of the Common Grid Model Exchange Standard (CGMES) to be used as the baseline exchange standard for the implementation of the Common Grid Model methodologies and approved the roadmap for implementation of the data exchange format for the purpose of Network Code data exchanges.

This means that by January 1st 2017, all ENTSO-E TSOs shall have prepared their tools to be able to exchange their individual grid models (IGMs) for year-ahead scenarios, month ahead scenarios (where applicable), week ahead scenarios (where applicable), two days ahead scenarios, day ahead scenarios and intraday scenarios and even real-time snapshot cases (where applicable) compliant with the CGMES 2.4 specification. This is an important precondition to migrate the existing business processes based on UCTE-DEF based exchanges, including real-time snapshots (where applicable), towards CGMES based exchanges and to implement new Common Grid Model (CGM) business processes in line with the European Regulations for Capacity Allocation and Congestion Management, Forward Capacity Allocation and Electricity Transmission System Operation.

TSOs and any entity providing services for TSOs are preparing their tools and processes to respect this target date. It means that many TSOs will be ready asynchronously before this target date and may be able to exchange their grid models into this new format on a daily basis.

This fact has a major impact on the existing business processes of the synchronous area of Continental Europe, in which data models are being exchanged daily in the UCTE Data Exchange Format since 2006. Those models are merged to provide a starting case for Capacity Calculations, in two-days-ahead, and Security analysis in both day-ahead and intra-day process.

When a single TSO migrates from UCTE DEF to CGMES the whole synchronous area of Continental Europe will be impacted if we cannot ensure a continuous and smooth transition from UCTE DEF to CGMES based model exchanges.

It is also important to support TSOs that are already able to provide CGMES files in order to make them benefit from this new format.

The following chapters describe how the migration is designed to be done. The migration is scheduled to end on January 13th 2018, and is split into four phases:

1. Development Phase
2. Transition Phase
3. Stability Phase
4. CGMES Operational Phase

Ending one phase and starting the next phase is subject to SOC approval.

2 GLOSSARY OF TERMS

ATOM	All TSO non-real-time Operational and operations-Market-related data network
Boundary MAS	Boundary Model Authority Set
CGM	Common Grid Model
CGMA	Common Grid Model Alignment
CGMES	Common Grid Model Exchange Standard
CGMM	Common Grid Model Methodology
EMF	European Merging Function
EQ profile	Equipment profile, defining the characteristics, connectivity and containment of the grid elements
IGM	Individual Grid Model
MVS	Minimum Viable Solution
OPDE	Operational Planning Data Environment
OPDM	Operational Planning Data Management
PEVF	Pan-European Verification Function
PT CGM	Project Team Common Grid Model
QAS	Quality Assessment Service
RGCE	Regional Group Continental Europe
RSC	Regional Security Coordination
SSH Profile	Steady -States Hypothesis profile, defining the input data for setting up a power flow case in terms of energy injections, switching states and tap positions and controls (target values for regulating controls)
SV Profile	State -Variables profile, defining the result of a power flow calculation, in terms of voltage magnitude and angle on topological nodes, power flows through terminals, shunt compensator sections, transformer and phase shifter steps and in service status of equipments
TP Profile	Topology profile, defining the result of topology processing in terms of associations between terminals and topological nodes ("buses") and, if applicable, between connectivity nodes and topological nodes

3 THE MIGRATION PROCESS

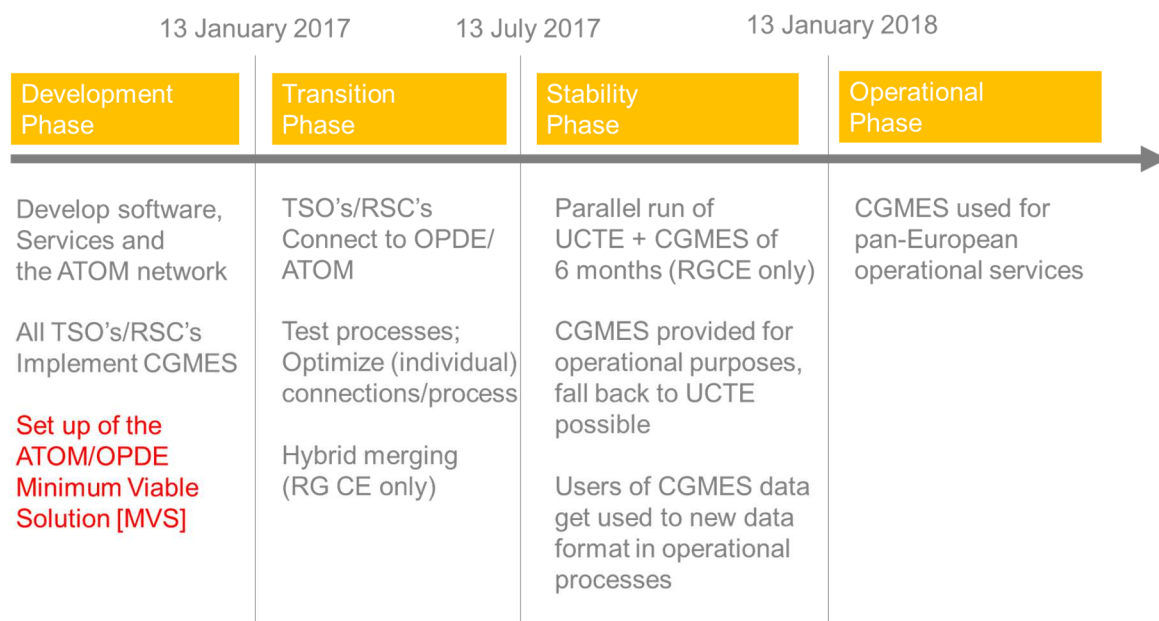


Figure 1 – High Level CGM Program planning

Stepwise migration

Migration from UCTE-DEF to CGMES concerns Continental Europe TSOs only. All ENTSO-E TSOs are expected to connect to OPDE and prepare their business processes for CGMES exchanges in line with the phases and timelines detailed in the following sections.

3.1 PHASE 1: DEVELOPMENT

During the development phase, not all TSOs have implemented CGMES in their domestic environment. Files are exchanged manually and the main goal is to achieve CGMES conformity, interoperability and bug fixing. The development phase will end as soon as the OPDE/ATOM minimum viable solution has been installed. This is planned for January 13th 2017.

3.1.1 MATERIAL EXCHANGED

Only UCTE DEF IGMs are exchanged on a mandatory base and for operational purposes, and only UCTE DEF CGMs are provided by merging entities, for Continental Europe TSOs.

Exchanged material will be:

- Continental Europe TSOs send individual UCTE DEF IGMs
- Merging Entities merge the IGMs into UCTE DEF CGMs



Figure 2 – Phase 1: one process in UCTE DEF

But in parallel, all ENTSO-E TSOs are implementing CGMES import/export functionality on their domestic tools, participating to the interoperability tests organized by PT CGM, WP4 with support of RSCs. In addition, all RSCs are implementing the CGMES import/export functionality and the European Merging Function (EMF) requirements in their tools in order to implement the EMF.

At this stage, CGMES IGM exchanges are performed manually, without the target solution architecture (OPDE). This OPDE will be delivered in a two-step approach:

1. OPDE/ATOM Minimum Viable Solution
2. OPDE final target Solution & ATOM final target Solution

3.1.2 OPDE SOLUTION

PT CGM Work Package 3 is developing OPDE software and services, and coordinating the work to build the ATOM network during this phase in order to support IGM exchange of files, and the CGM delivery process. Additional tools and central services are to be connected to OPDE in order to support the CGM delivery process:

- QA Portal
- Boundary Management
- Pan-European Verification Function
- Common Grid Model Alignment

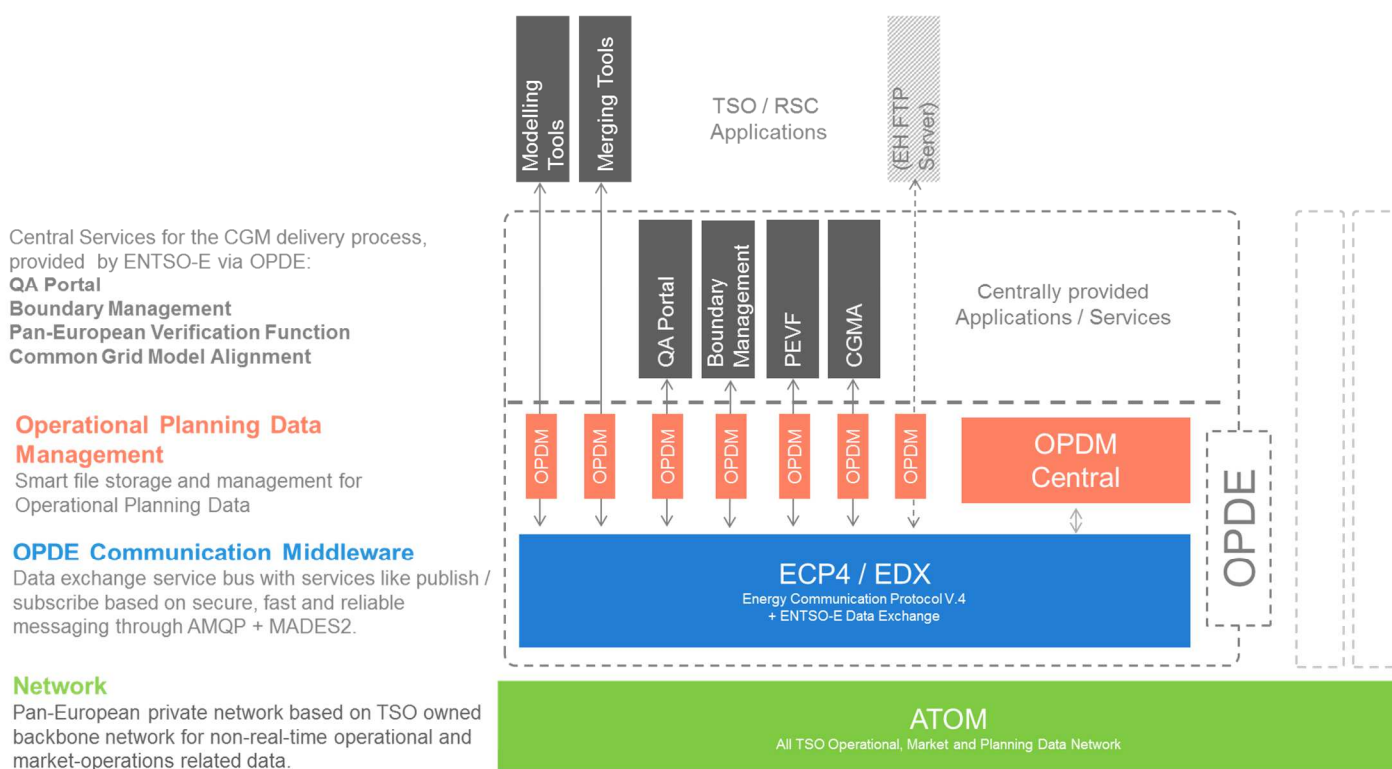


Figure 3 – The OPDE Vision

The OPDE Minimum Viable Solution to be implemented during this Development Phase is based on a limited number of core TSOs (Amprion, APG, RTE, Swissgrid) and RSCs (Coreso and TSCNET) hosting and operating the OPDE, allowing the other TSOs to connect initially via Internet (temporary) or via a connected regional Private Network.

Some central services will not be redundant for this Minimum Viable Solution (MVS), but it will allow all TSOs to benefit from the first CGMES CGM delivery.

Application	MVS		Target	
	#RSCs on backbone operating	#RSCs on backbone providing fallback	#RSCs on backbone operating	#RSCs on backbone providing fallback
ECP4 / EDX (central)	1	0	1	1
OPDM (central)	2	0	6	0
QA Portal	1	0	1	1
Boundary Management	1	0	1	1
CGMA	1	0	1	1

Figure 4 – The OPDE Minimum Viable Solution vs Final target Solution¹

¹ DISCLAIMER: Final target solution represents current thinking and is yet to be approved. Numbers presented may be subject to change.

3.2 PHASE 2: TRANSITION

The Transition Phase will start on January 13th 2017, subject to the preconditions mentioned below and is scheduled to end of 13th of July 2017. During the transition phase, not all TSOs will be connected yet to the OPDE. This implies that an industrialized CGMES exchange cannot be achieved for all TSOs, but this phase aims to prepare for industrialized CGMES exchanges.

The focus during the transition phase is thus on getting ready for industrialized CGMES based exchanges while ensuring business continuity for current UCTE-DEF based exchanges and getting all TSOs (and RSCs) connected to the OPDE.

Precondition to start Transition Phase:

- OPDE Minimum Viable Solution is up and running
- OPDE infrastructure is ready to connect to TSOs & RSCs
- OPDE software is in operation, it is synchronized with the respective FTP server(s) for UCTE data
- Central services² are in operation (Quality Assessment Service, Boundary Management, Pan-European Verification Function)

3.2.1 CGMES EXCHANGE PROCESS

All Continental Europe TSOs still have to continue sending their UCTE-DEF IGMs as before, even if they already send CGMES IGMs, as the UCTE DEF based processes are still the primary processes. This is very important in order to guarantee a robust and smooth UCTE-DEF process for all entities not yet connected to the OPDE and for regional processes that are not yet CGMES compliant.

The Transition phase however brings a change, as TSOs that are already connected to the OPDE will have the possibility to exchange CGMES data on a daily basis in order to test & finetune their business processes. This includes TSOs in the synchronous area of Continental Europe. In order to support those TSOs from this moment of time, RSCs will merge CGMES IGMs with surrounding TSOs areas in UCTE-DEF format, in order to deliver a merged Continental Europe solution in CGMES, the Hybrid CGMES CGM. It means that in order to do so, UCTE-DEF files will be converted at one stage in the so-called pseudo-CGMES³ format. Merging entities commit to support such hybrid merge models.

It is not foreseen to deliver a hybrid merged model in UCTE-DEF format because conversion from CGMES into UCTE-DEF would decrease quality of models. The conversion from UCTE-

² CGMA central service is not mandatory at this stage

³ Pseudo-CGMES shall not be confused with CGMES at all times. CGMES allows much more details than pseudo-CGMES

DEF to CGMES does not face this issue, and is made possible by the introduction of the so-called pseudo-CGMES. Many tests have shown its feasibility.

QAS portal will be used to both monitor the progress and display the validation results in a transparent manner.

Summarizing, there are two exchange processes that will run independently in parallel, and exchanged material will be:

- Continental Europe TSOs continue sending individual UCTE-DEF IGMs for their operational business processes
- TSOs already connected to OPDE send CGMES files (Pan-European⁴) for testing purposes

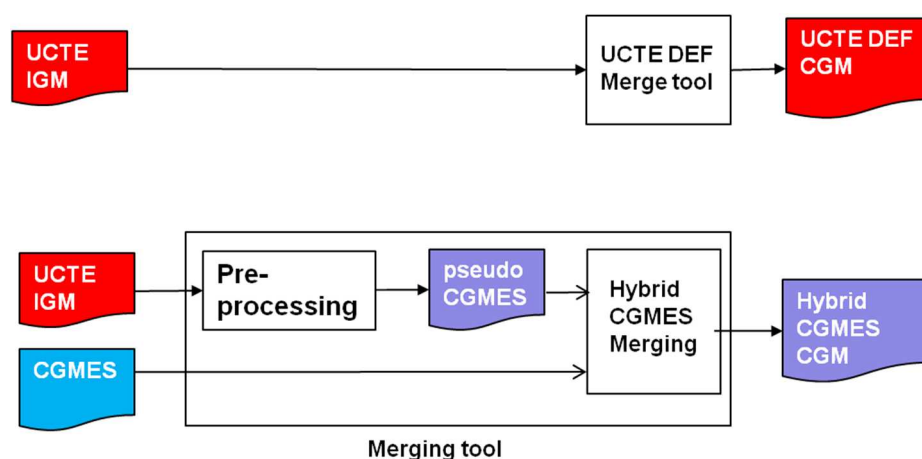


Figure 5 – Phase 2: two processes in parallel, UCTE DEF and Hybrid

⁴ At this stage, any TSO can deliver its CGMES IGMs. The only condition to merge several synchronous areas is to have complete synchronous areas

3.2.2 TRANSITION PHASE - IT ORGANIZATION

When a TSO has no OPDE node (OPDM client), it must exchange UCTE-DEF files with its current EH connection to the EH-FTP server.

When a TSO has installed its OPDE node (OPDM client), it must still exchange UCTE-DEF files with its current EH connection to the EH FTP server and CGMES IGMs with its OPDM client. CGMES files will not be synchronized with EH FTP server, they will be available through OPDE exclusively. UCTE DEF files are replicated to the OPDE cloud as input for the hybrid merging process, this task is performed by OPDE.

The RSCs will upload their merged UCTE-DEF files to the EH-FTP server via their EH connection.

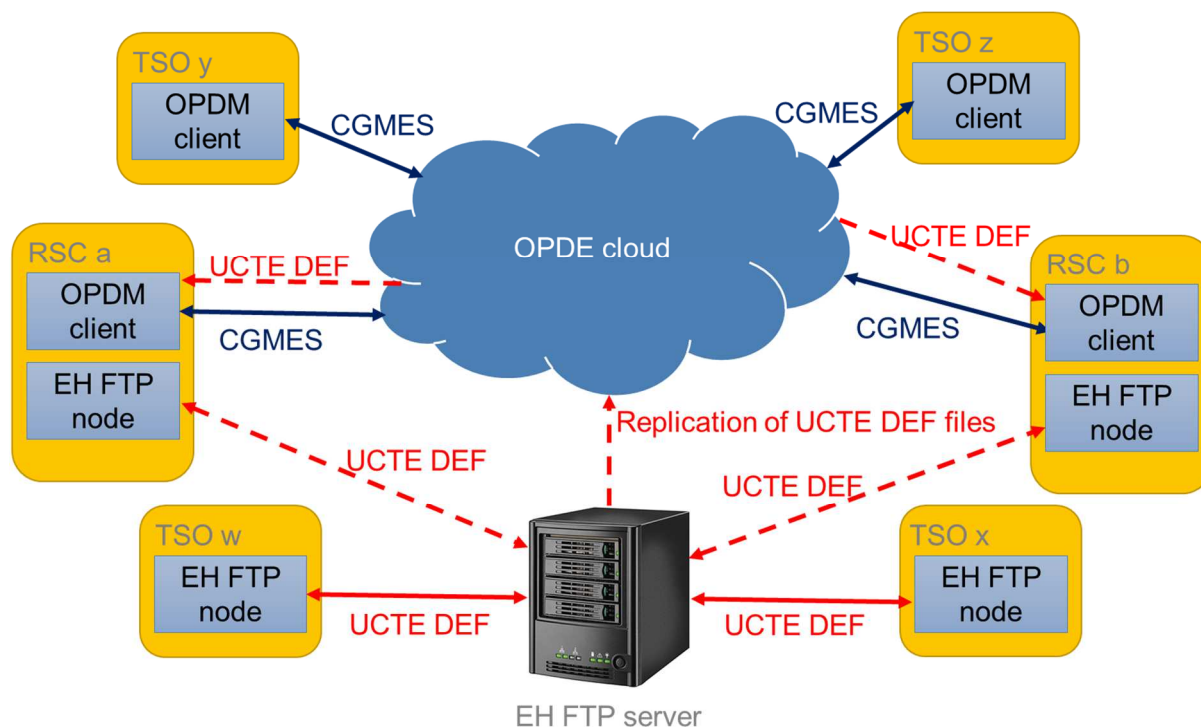


Figure 6 – OPDE connection and replication of UCTE files from the EH-FTP server

3.3 PHASE 3: STABILITY

The Stability Phase is planned to start on July 13th 2017, subject to the preconditions below, and will last for six months (up to January 13th 2018). The stability phase focusses on a stable, robust and well performing business process for all time horizons (applicable to time horizons defined in CACM NC and SO GL), based on an industrialized exchange process.

As it is mandatory to be CGMES compliant on July 13th 2017, WP4 EMF requests all Continental Europe TSOs to continue sending UCTE-DEF files for two days-ahead process (when applicable), day-ahead process, and intra-day process (when applicable) up to beginning of 2018, whatever their CGMES readiness is. It is clearly expected to continue a parallel process sending UCTE-DEF files even after CGMES readiness.

A fallback process with UCTE-DEF models shall be available for TSOs in case the CGMES process faces a major issue. RGCE TSOs must exchange the UCTE-DEF models during the whole stability phase period.

The fallback process entails only updating the UCTE-DEF models in case the CGMES process fails for a specific time horizon, so the process will not run in parallel in its full extent (e.g. model improvements, remedial actions).

The decision proposal for SOC to enter the stability phase will include specific conditions for triggering the fallback process based on UCTE-DEF exchanges.

Preconditions:

- OPDE is fully operational, meaning that final target is implemented, not only the Minimum Viable Solution.
- CGMA service is operational.
- Connections of all TSOs and RSCs to the OPDE in operation
- All CGMES IGMs are provided (at least for Continental Europe, and if possible with all other synchronous areas) before starting this phase (SOC decision to exchange CGMES by January 13th 2017).
- Target Net Positions and target flows in HVDC interconnectors have to be available through the PEVF and CGMA.
- Boundary Platform is connected to OPDE and is fully operational
- Quality Assessment Service Portal is fully in operation to provide quality feedback to IGMs submitted by TSOs.
- TSO operational tools that participate in the business processes for all relevant time horizons have passed CGMES conformity assessment in line with relevant test use cases defined in annex 1.
- Merging Tools have passed CGMES conformity assessment in line with annex 1 and EMF conformity assessment (Mandatory Migration and Mandatory Final requirements).

3.3.1 STABILITY PHASE – CGMES EXCHANGE PROCESS

When entering the Stability phase, all ENTSO-E TSOs (pan-European!) must be connected to OPDE and fully CGMES compliant. In addition, all TSOs shall be able to deliver CGMES IGMs. **Consequently hybrid merge will not be supported anymore in this stage.**

It is mandatory for Continental Europe TSOs to continue sending in parallel their UCTE-DEF IGMs to ensure a back-up process during the entire Stability phase.

Exchanged material will be:

- All TSOs (Pan European) send CGMES IGMs
- Continental Europe TSOs send UCTE-DEF IGMs (as a back-up)
- Merging Entities merge models into CGMES CGMs, and UCTE-DEF CGMs as a back-up (2 uncoupled processes)

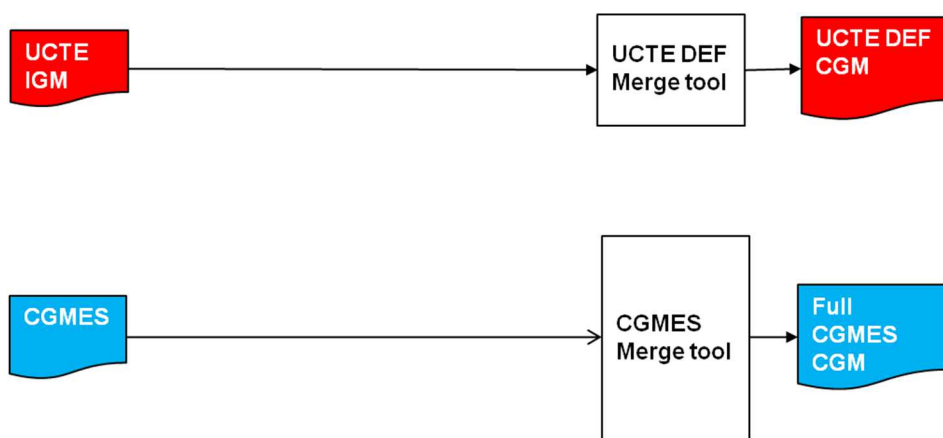


Figure 7 – Phase 3: two processes in parallel, UCTE DEF and CGMES

3.3.2 STABILITY PHASE - IT ORGANIZATION

IT Organization will be the final target solution, ensuring that every TSO has an OPDE connection to ATOM Backbone network

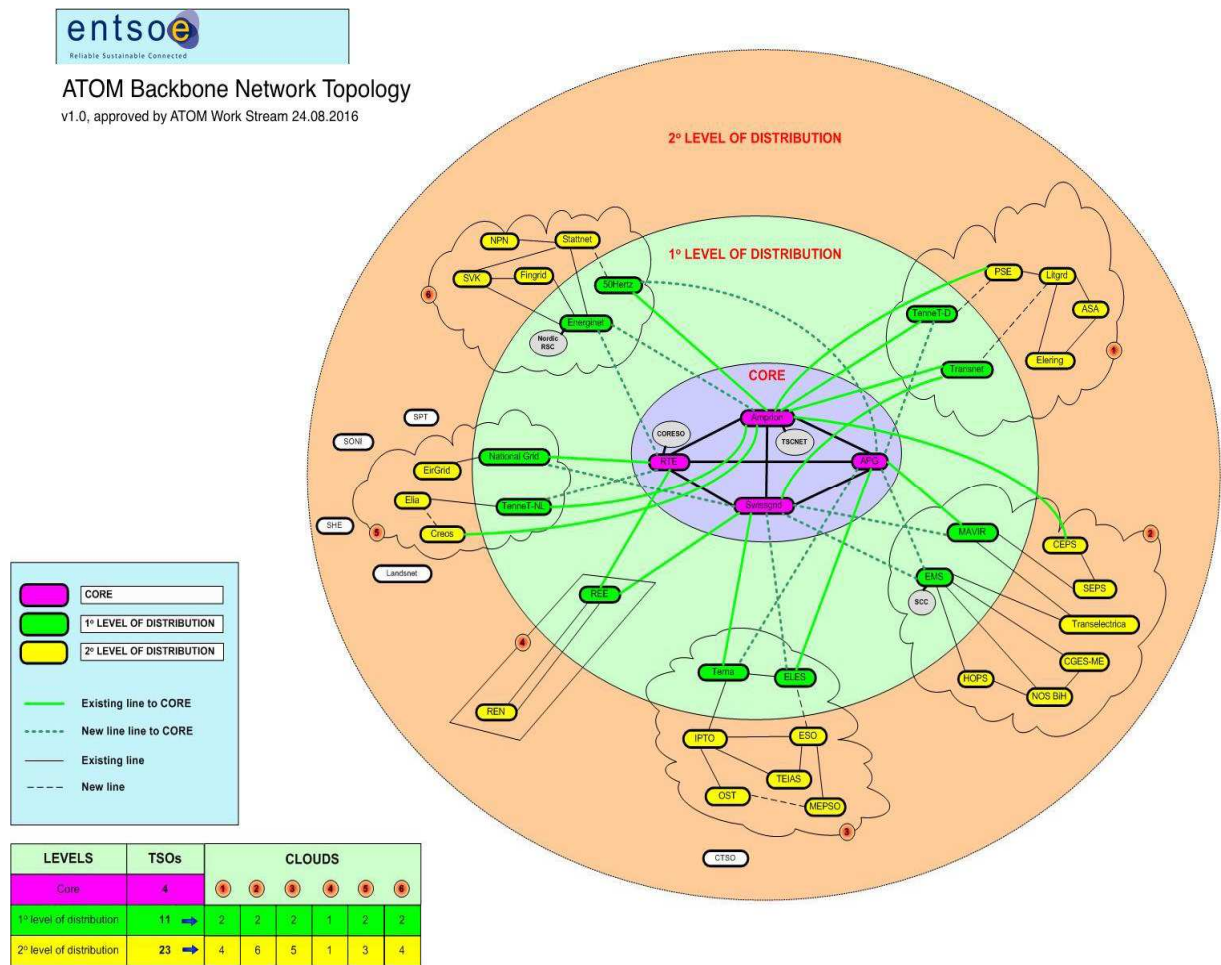


Figure 8 – ATOM Backbone network⁵

In addition, Central services will be redundant as described in Figure 4, and OPDM service provider will be redundant at every RSC (six nodes are expected at this date).

⁵ DISCLAIMER: On 15th of September 2016, SOC only approved the CORE solution of the ATOM Backbone network. Connectivity details of TSOs outside the CORE are yet to be agreed.

3.4 PHASE 4: CGMES OPERATIONAL

The operational CGMES phase is expected to start on January 13th 2018. At this moment in time, all ENTSO-E TSOs are supposed to be confident in their CGMES models (IGMs and CGMs) and associated operational processes.

Preconditions

- Quality:
 - Individual and Global quality of IGMs & CGMs need to respect Minimum Requirements from “Quality of CGMES Datasets and Calculations” (No Fatal errors)
 - TSOs and RSCs have to be confident in their CGMES models and results. Capacity Calculation, and Security Analysis shall lead to reliable results
- Performance:
 - IGM files are publically available on OPDE in accordance with CGMM gate closure timelines
 - For any time horizon, the CGM (i.e. updates SSH files for each TSO and SV files for all synchronous areas and for the pan-European region) for all scenarios of a particular business day are publicly available⁶ on OPDE within 15 minutes after starting the merging process
- Robustness:
 - Incomplete datasets shall not lead to abortion of the process (substitution process)

3.4.1 OPERATIONAL CGMES PROCESS – EXCHANGE CGMES PROCESS

At this stage, only CGMES IGMs will be exchanged and merged for all time horizons. UCTE-DEF IGMs will not be supported anymore.

Exchanged material will be:

- All TSOs (pan European!) send CGMES IGMs
- Merging Entities merge these CGMES IGMs into CGMES CGMs



Figure 9 – Phase 4: One process, all in CGMES format

⁶ This means that the merge and power flow process has run, the respective files have been uploaded via the OPM client and validation steps 1-7 have been successfully completed

3.4.2 OPERATIONAL CGMES PHASE – IT ORGANIZATION

Only the OPDE target infrastructure will be used for the CGMES based exchanges.

Annex 1

CGMES conformity level of tools

In order to be able to participate in the IGM/CGM business processes TSO tools (or the combination of tools involved in these business processes) and EMF tools must have been tested against the following test use cases of the CGMES conformity assessment framework:

- TUC 01: import of Boundary Set instance data
- TUC 02: import of Equipment profile instance data⁷
- TUC 03: import of Topology profile instance data⁸
- TUC 04: import of Steady State Hypothesis profile instance data
- TUC 05: import of State Variables profile instance data⁹
- TUC 09: import of multiple profiles instance data
- TUC 10: import of difference instance data of a profile¹⁰
- TUC 14: Export of Equipment profile instance data
- TUC 15: Export of Topology profile instance data
- TUC 16: Export of Steady State Hypothesis profile instance data
- TUC 17: Export of State Variables profile instance data¹¹
- TUC 21: Export of multiple profiles instance data
- TUC 29: Perform load flow calculation
- TUC 37: Handle power transform. Tap changers and phase shift transformers
- TUC 38: Handle generation types
- TUC 39: Handle shunt compensators
- TUC 40: Maintain hierarchy of the model
- TUC 41: Handle HVDC modelling
- TUC 42: Manage dependencies between instance data from different profiles of the CGMES
- TUC 43: Handle equivalent elements
- TUC 44: Handle regulating controls

⁷ Note that bus branch tools may need to import EQ core and TP together, which is to be tested in TUC 09.

⁸ Note that node breaker tools don't need to import TP models as they can run topology themselves. Nevertheless, if they want to consume SV data, they need to be able to import TP profile instances as well in order to obtain the referenced topological nodes

⁹ Necessary if the CGM SV data is used to initialize the domestic power flow base case solution

¹⁰ Necessary to be able to process updates in EQ models (dynamic line rating, equivalent DSO networks)

¹¹ Note that the SV data **must** refer to the input data used (i.e. a DependentOn statement for both TP and SSH data)